Pamphlet No. 22

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TANGANYIKA TERRITORY

DEPARTMENT OF AGRICULTURE

Fourth Annual Report of the Coffee Research and Experimental Station, Lyamungu, Moshi 1937

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The Annual Reports for the year 1937 of:

(i) the Sisal Research Station, Ngomeni, Tanga;

(ii) the Morogoro, Mpanganya, Ukiriguru, Lubaga and Iheme Experimental Stations

are published separately in pamphlet form.

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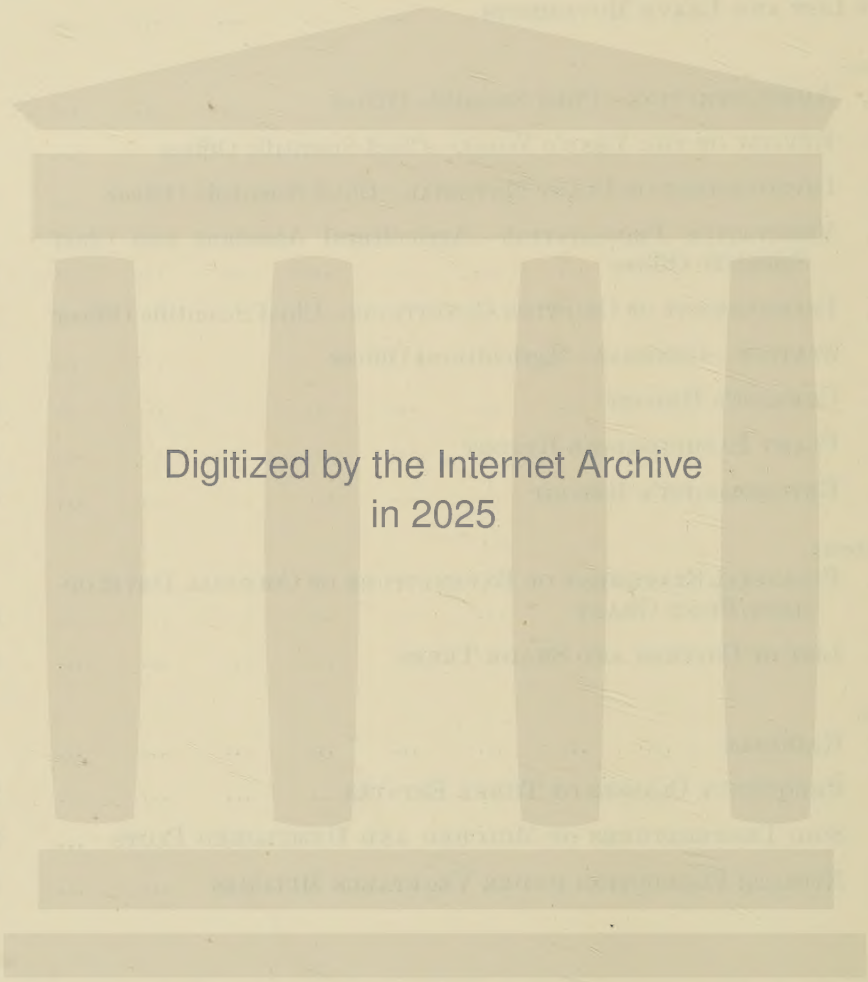

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COFFEE RESEARCH AND EXPERIMENTAL STATION, LYAMUNGU, MOSHI.

Report for the Period 1st January to 31st December 1937.

Staff List.

Chief Scientific Officer in general charge.—S. M. Gilbert, B.SC., N.D.A., Dip. Agric. (Wye).
Plant Pathologist.—G. B. Wallace, B.SC., PH.D.
Entomologist.—F. B. Notley, M.SC., A.I.C.T.A.
Chemist.—H. B. Stent, M.SC., A.I.C., A.I.C.T.A.
Agricultural Officer.—F. R. Sanders, B.A. (Hons.), Dip. Agric. (Cantab).
Agricultural Assistant (Plant Propagator).—C. B. Gibbins.
European Clerk.—C. H. Taylor.

Leave Movements during the Year.

	Departed	Returned
Mr H. B. Stent	— ...	19th February 1937
Mr C. H. Taylor	15th March 1937 ...	28th October 1937
Dr G. B. Wallace	15th March 1937 ...	12th December 1937
Mr C. B. Gibbins	22nd April 1937 ...	16th November 1937
Mr F. B. Notley	24th August 1937 ...	—

Section I.

Administration.

This year completes the fourth since steps were taken to establish a station for research and experiments on coffee in Tanganyika Territory.

As with the coffee bush itself, so with an institution studying its needs a period of years is required in which to bring the "tree" (of knowledge) into bearing. It may now be reported that this tree is ready to bring forth fruit and a steady and increasing "crop" of results may be expected. The following sections show how far this claim is justified.

With understanding of the objects of the station increased interest among producers has developed and is of no little encouragement to the staff. This understanding has been advanced considerably by the numerous contacts between producers and the staff.

VISITORS.

Mr G. Milne, Soil Chemist, East African Agricultural Research Station, made the station his headquarters for five weeks.

Numerous colleagues from neighbouring territories and from Amani were welcomed and not least among these were several workers on similar problems in the Belgian Congo. These visits have already led to benefits to the station in the matter of publications or material.

The West Meru, Usa and Kilimanjaro Planters' Associations paid organized visits and as a result the two former associations have sent regular delegations during the year. These visits have been invaluable in effecting close and cordial relations between planters and staff.

VISITS OF STAFF TO PRODUCERS.

The Chief Scientific Officer attended meetings of the West Meru, Oldeani, Usambara and Southern Highland Associations during the year.

In the Northern province the Agricultural Officer has devoted much more time to advisory work. In all members of the staff have paid some two hundred visits to estates.

MISCELLANEOUS CONTACTS.

The General Council of the Tanganyika Coffee Growers' Association, the Coffee Board and the Inter-territorial Coffee Producers' Committee have held meetings at Lyamungu. The Committee of Management met in August. The Chief Scientific Officer attended Planters' Days and Coffee Conference in Nairobi.

PUBLICATIONS.

Quarterly Notes have been published regularly throughout the year, the printing of the December number being undertaken for the first time by the Tanganyika Coffee Growers' Association.

Several articles by members of the staff have been accepted by the *East African Agricultural Journal*. Articles on technique of field experiments by the Chief Scientific Officer have been accepted by *Tropical Agriculture*.

BUILDINGS.

The coffee factory and drying shed are almost complete. The former is designed for both estate-scale and experimental work and embraces a syphon receiving tank, a pulper with sieve and a repasser. A second story provides a laboratory for work on quality in coffee. The equipment includes hand pulpers, peeler and polisher for samples and a Uno coffee roaster and mill.

FINANCE.

In addition to the services of the Plant Pathologist, Entomologist and Agricultural Officer, funds of the Station to the extent of £776 have been voted from Departmental sources to augment the free grant of £4,000 from the Colonial Development Fund. (*See* appendix I.)

STOCK.

Experience points to the necessity for the keeping of stock by means of which ample organic matter may be available for the coffee.

Accordingly, an adequate herd of stock is being gradually accumulated. At present it consists of ten cows and heifers, four oxen, one bull and eight calves. The policy is to grade up Mbulu foundation stock by selection. The station appears, at present, to be free of East Coast Fever.

SUB-STATION—MBOSI.

The station has opened a sub-station at Mbosi in the Southern Highlands. It comprises ten acres and it will be used mainly for improvement of plant material for that area. Nurseries for coffee, shade trees and cover crops have been started and compost making commenced. The local Agricultural Officer has kindly supervised this work.

Section II.

Review of the Year's Work.

Owing to unavoidable absence of over half of the staff on leave during the greater part of the year a considerable strain has been placed on the remainder in maintaining the various lines of work.

Station Development.—On the station itself further areas of land have been prepared for experiments. Considerable attention has been paid to planting up areas of bananas and fodder grasses for cattle food, for mulching and for compost making. Immediately after opening up new land measures to prevent erosion have been taken, the routine method being contour ridges planted with a suitable hedge plant.

Table I.

Development	Acres
Coffee	41
Nurseries	4
Paddocks	9
Planted with coppices, wind belts, etc.	20
In course of preparation for experiments	124
Forest	30
Roads, buildings, gardens, etc.	25
Unopened up, other than forest	57
Total Area ...	310

Two demonstrations and part of an experiment on the effects of age of coffee in regard to seasonal influences, have been planted.

Some sixteen acres have been prepared for six latin squares, each comprising thirty-six plots, on which to test a number of seed selections.

Meteorology.—The rains have been phenomenal, amounting to over 2,557 millimetres (100 inches), the heaviest recorded in the Territory. Of this 2,189·7 millimetres (86·2 inches) fell in the first six months, and 1,730 millimetres (68 inches) in seven weeks. It is a tribute to the anti-erosion measures adopted that no serious breakages occurred. Useful rains, well distributed, fell during the last half of the year. Table II summarizes the meteorological data for 1937.

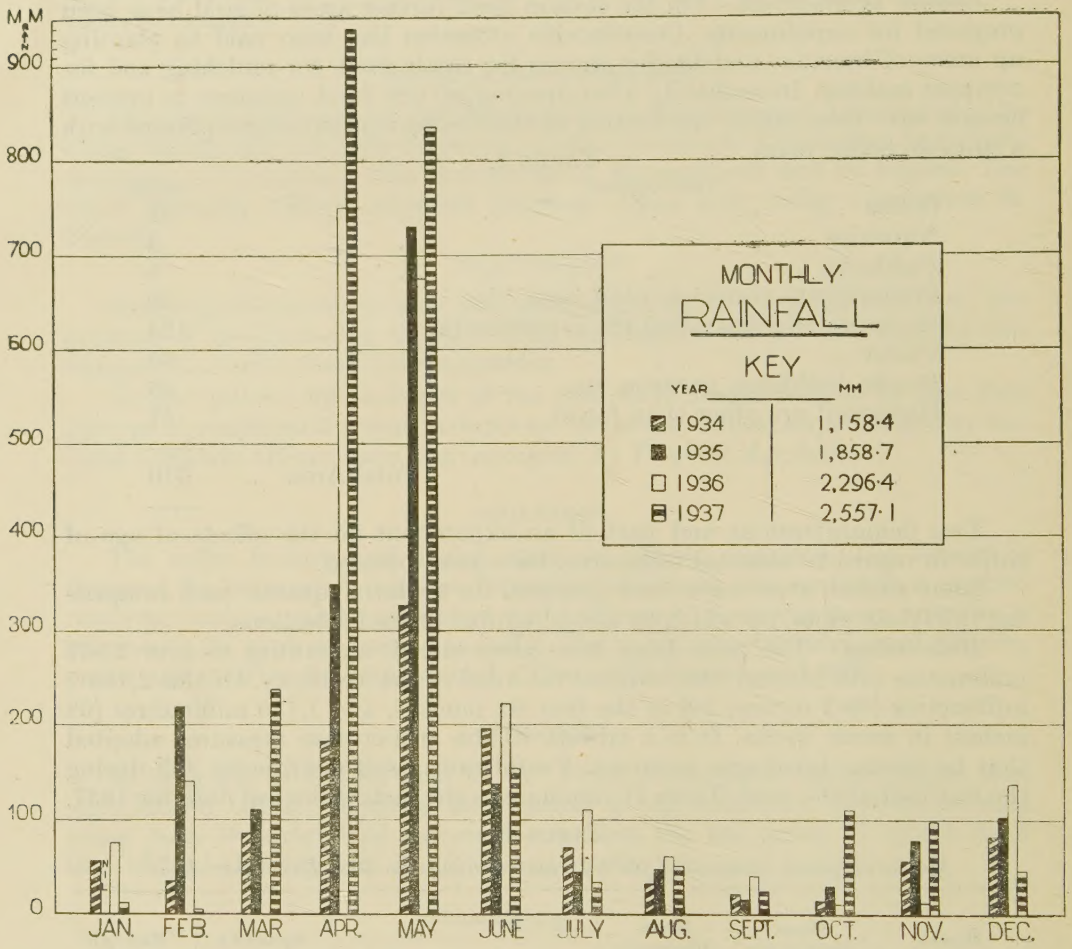
Table II.

Meteorological Summary for the year ending the 31st December 1937.

Month	Mean Maximum	Mean Minimum	Humidity		Sunshine	Rainfall
			9 a.m.	3 p.m.		
			per cent	per cent	hours	mm.
January ...	28·6	14·6	72	48	246	8·3
February ...	29·9	14·6	70	44	208	3·3
March ...	27·6	15·8	79	55	178	239·9
April ...	23·0	16·1	91	77	68	945·6
May ...	21·7	15·7	90	78	58	839·5
June ...	20·3	14·5	94	80	31	153·1
July ...	20·5	13·3	88	66	87	31·3
August ...	21·3	13·0	85	59	101	58·2
September	24·3	13·2	88	56	155	26·2
October ...	23·8	14·6	86	64	119	110·6
November...	26·3	14·8	84	66	199	99·4
December	26·5	15·2	81	56	192	41·7

Graph I sets out the rainfall for four years. So far it is quite impossible to talk about "average" rainfall. The effects of such wide variation on the results of experiments can easily be imagined.

Graph I



IMPROVEMENT OF PLANT MATERIAL.

Recording has been completed on numerous trees for the fourth successive year. Many among potential selections, while still on average very heavy bearers, have shown very erratic yields. These have been retained for further examination but preference has been given to trees showing more regular bearing. Less than a dozen have never fallen below a yield of 200 ounces in any one year.

Examination of bean characteristics has continued and with additional knowledge the work has been simplified. A random sample of at least 350 beans from the whole crop of any tree together with weight of bean gives the bulk of the information required.

Seeds of individual selections have been planted in nurseries in several areas for field tests in 1938. It is hoped that these trials will answer finally the question as to whether seed selection for yield does give crops above average.

It is reiterated, however, that the mass propagation by vegetative means of trees selected for desirable qualities is one of the principal aims of the work at this station.

Introductions of an additional five species of *Coffea* have been effected through the good offices of the Royal Botanic Gardens, Kew. The collection now comprises nineteen different species.

IMPROVEMENT OF GROWING CONDITIONS.

Work on Estates and Native Holdings.—On thirty blocks recording of tree yields and growth measurements has been carried out. The Agricultural Officer, assisted by a team of recorders, has been responsible for this work.

No conclusive results, owing to the irregular bearing plant material, have emerged from the four "1936 series" experiments. Much useful information has, however, been collected.

Treatments were applied, or compost manufactured for application, on seven estates as was detailed in last year's report. Several new uniformity trials have commenced, one of which is on "multiple stem" coffee.

VEGETATIVE PROPAGATION.

This work has been continued in order to provide clonal material from potential selections and to obtain more uniform material for field experiments. Some fifteen hundred rooted cuttings have been planted in the field.

Suitable bulk material for cuttings is most readily obtained from multiple stem trees but unfortunately this method of growing coffee is practically non-existent in the principal coffee areas in this territory. Rooted cuttings of selections are now being grown on this system at the station, but it will require about three years before they provide a plentiful supply of cuttings.

The rooting of cuttings proves comparatively simple in the cool season, but in the hot weather many troubles have arisen, *Rhizoctonia* being the chief.

The average length of time which cuttings have taken to root has been eighteen weeks. With the use of growth hormones semi-hard wood cuttings have rooted more quickly. There is reasonable doubt, however, as to their value in accelerating the rooting of soft wood cuttings.

SOIL INVESTIGATIONS.

The Soil Chemist has carried out observations on the effect of vegetable mulches on the liberation of soil nitrate. A contrast is drawn between: (a) a mulch highly resistant to decomposition in the field, e.g. banana trash, which is beneficial; and (b) one which breaks down fairly readily and is possibly harmful, e.g. guinea grass. The survey of soil in connection with field experiments continues and has been extended.

PLANT PATHOLOGY.

Owing to the absence of the Pathologist from the station on home leave from the 7th March to the 12th December there is little to report.

Hemileia continued to spread in the Southern Highlands and its control in the luxurious growing native coffee at Tukuyu is a difficult problem. Field experiments on the control of this disease in the Northern province continue.

The Entomologist was absent on home leave from the 24th August until the end of the year.

Thrips caused considerable damage at the beginning of the year, and work has been carried out on the forecasting of outbreaks and the control of this pest. Antestia was little in evidence, and projected experiments were held up. Leaf-miner has probably been the most serious pest of the area, causing very considerable losses, and since no control measure is known for this pest a thorough investigation of the two species concerned and their parasites was commenced. Some work on the relation between mulches and *Dasus* (*Gonocephalum*) *simplex*, the dusty ground beetle, was carried out.

Lyamungu,
March 1938.

S. M. GILBERT
Chief Scientific Officer

SECTION III.

IMPROVEMENT OF PLANT MATERIAL.

Selection.—In the 1936 Annual Report were placed on record the somewhat tedious details of the research into bean characteristics.

With the exception of the effects of season this preliminary essential to selection proper in the field was completed. The work might rightly be described as a genetic survey. As a result it is known that a few simple measurements will characterize the crop of any one tree and it is now possible to undertake the examination of any trees which planters may bring to our notice. The question of liquor, a vastly important problem, is being undertaken elsewhere.* Simple instructions have been issued by means of Quarterly Notes† as to the routine to be adopted by those wishing to commence to pick out potential selections.

Further attention this year has been given to bean weight and as a result it is known that:—

(a) A random sample of all pickings must be taken to characterize a tree since different pickings are significantly different in their bean measurements.

(b) The number of beans in the random sample must be more than 350. (*See* table III.)

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*Annual Report for 1936 of the Kenya Coffee Board.

†No. 3, September 1937, page 3.

Table III.

Frequency Table for Bean Weight—Tree G55.

Central Weight	Pickings							Total	+or— Deri-vation
	2	3	4	5	6	7	8		
0·075	—	—	—	—	—	7	14	21	— 8
0·085	—	—	—	3	14	9	20	46	7
0·095	—	—	—	4	12	22	30	68	6
0·105	—	1	2	17	33	57	69	179	5
0·115	2	4	3	40	49	77	83	258	4
0·125	—	3	4	55	80	108	120	370	3
0·135	2	8	6	84	126	138	175	539	2
0·145	5	10	30	125	171	173	186	700	— 1
0·155	9	16	38	174	168	179	171	755	0
0·165	18	27	42	208	171	144	109	719	1
0·175	32	32	42	161	102	132	84	585	2
0·185	36	46	36	115	52	75	44	404	3
0·195	35	50	21	39	39	43	25	252	4
0·205	43	22	9	10	14	8	5	111	5
0·215	26	16	5	4	4	—	1	56	6
0·225	15	5	2	1	1	—	1	25	7
0·235	7	1	—	2	2	—	—	12	8
0·245	5	—	—	2	—	—	—	7	9
0·255	—	—	—	—	1	1	2	4	10
0·265	—	—	—	—	1	1	1	3	11
0·275	—	—	—	—	—	—	—	—	12
0·285	—	—	—	1	—	—	—	1	13
0·295	—	—	—	—	—	—	1	1	14
0·305	—	—	—	1	1	—	—	2	15
0·315	1	—	—	—	1	—	—	2	16
0·325	—	—	—	—	—	—	—	—	17
0·335	—	—	—	—	—	—	—	—	18
0·345	—	—	—	—	—	—	—	—	19
0·355	—	1	—	—	—	—	—	1	20
0·365	—	1	—	—	—	—	—	1	21
Total ...	236	243	240	1,046	1,042	1,174	1,141	5,122	
Mean	·193	·182	·169	·159	·152	·149	·143	·155	
Standard deviation	·025	·029	·021	·023	·026	·026	·027	·028	
Co-efficient of variation	12·74	15·63	12·59	14·66	17·04	17·47	18·68	18·38	
*"n"	162	243	159	215	290	305	349	337	

*Figure "n" calculated for P = ·05 and ·02 of the mean.

Indications had already been obtained that weight was positively correlated with length, width and boldness of bean. If it could therefore be shown that volume was positively correlated with weight much irksome measuring could be avoided. With the assistance of the chemist correlation between weight

and volume was worked out on a number of trees. The results are tabulated below:—

TABLE IV.

Correlation between Weight and Volume.

Tree No.			r
H·66	...	...	+ 0·998
H 88	...	...	+ 0·996
J 102	...	...	+ 0·995
J 104	...	...	+ 0·971
D 576	...	...	+ 0·991
Q 221	...	...	+ 0·982

Mean $Z^1 = 2{\cdot}786$ $X^2 = 120{\cdot}42$.

Standard error of mean $Z^1 = 0{\cdot}0415$.

Standard error of difference between 2 means = 0·144.

Mean of r = + 0·992 N = 100.

As a result of this work the weight alone of a random sample (N = 350) from the whole crop of any one tree gives considerable information necessary in selection. Screening for shape completes the measurements.

It is now possible to fix standards for selecting "mother" trees for vegetative propagation. They are briefly:—

(a) A tree suitable horticulturally to the district it is designed to serve.

(b) A vigorous healthy specimen.

(c) An average regular yearly yield of 1½kg. (say 3lb.) of parchment coffee (based on 9ft by 9ft spacing) for at least five years with as little fluctuation in yearly yields as possible.

(d) A good "out-turn," i.e. of clean marketable coffee.

(e) A minimum mean bean weight of 0·150 of a gramme.

The following trees are the best that have been located to date.

TABLE V.

Five best trees and their characteristics.

Tree No.	Mean yield kg. cherry per tree	Mean yield cwt. clean coffee per acre	Average weight of bean grammes	Width percentage A's (over 6·75mm.)	Boldness percentage over 4·198mm.
L 1	*9·6	19·5	0·170	72·25	5·00
N 39	*10·5	23·2	0·173	78·50	5·25
N 71	*9·4	20·8	0·150	44·50	9·75
N 197 ...	*9·9	21·9	0·167	65·25	12·00
R 3	†13·4	25·3	0·156	54·25	15·00

*Average of 4 years. †Average of 3 years.

Vegetative propagation of selections continues.

Seasonal Influence.

It has been possible to compare certain bean characteristics for the nine estates reported on in the 1936 report in regard to seasonal influences. Season

appears to have had a pronounced effect, in general beans were smaller in 1937. The details are given in the following tables:—

TABLE VI.

(a) *Bean Weight* (Grammes).

Analysis of Variance.

Source of variation	D.F.	Sum of squares	Mean square	½ Log*
Between seasons ...	1	·00083	·000830	4·4580
Between estates ...	8	·00070	·000088	5·3309
Residual	8	·00125	·000156	5·6172
Total ...	17	·00278	—	—

Seasons significant by "Z" test for P=·05=·8355.
Significant difference=·0125gm.

(b) *Bean Width* (Percentage A's).

Analysis of Variance.

Source of variation	D.F.	Sum of squares	Mean square	½ Log
Between seasons ...	1	187·54	187·54	2·6169
Between estates ...	8	379·67	47·46	1·9299
Residual	8	765·36	95·67	2·2804
Total ...	17	1,332·57	—	—

Not significant, but very suggestive.

(c) *Bean Boldness* (Percentage over 4·198mm.).

Analysis of Variance.

Source of variation	D.F.	Sum of squares	Mean square	½ Log
Between seasons ...	1	229·7	229·70	2·7184
Between estates ...	8	146·8	18·35	1·4548
Residual	8	103·9	12·99	1·2822
Total ...	17	480·4	—	—

Seasons significant by "Z" test for P=·01=1·2106.
Significant difference=3·602.

NOTE.—Estate C coffee abandoned.

Seedling Material.—It is not known with certainty that seedling plants from heavy yielders will give yields higher than average. To test this possibility selected seed has been planted out in nurseries in 1937 on about a dozen different estates embracing most of the coffee growing areas in Tanganyika Territory.

These seedlings will be planted out in the field in the form of latin squares of five or six replications in 1938. They have been so allocated as to serve also as variety trials as most squares contain at least one selection of Kent's, Blue Mountain, Bourbon and Java.

Lyamungu,
March 1938.

S. M. GILBERT
Chief Scientific Officer

*The figures are half log negative.

Section IV.

Vegetative Propagation.

Following on the lines found most successful in 1936, work was concentrated upon the rooting of cuttings. Unfortunately, early in the year a serious fungus disease occurred in the propagating cases which was identified by the Plant Pathologist as *Rhizoctonia* sp. The spread of the disease was rapid, and whole cases of cuttings rotted off completely in a very short time. Measures taken to check the spread of fungus included watering with Cheshunt Compound and sterilization of rooting materials. Up to this time sterilization had not been necessary.

ROOTING MEDIA.

Peat-moss, as stated in the 1936 report, was used both mixed with sand and alone. *Rhizoctonia* is certainly more prevalent in cases in which peat-moss is used, but it is now found in all cases periodically, irrespective of the rooting material used. Peat-moss is being persisted with on account of its potentialities. There is no doubt that cuttings callus and root quicker in this material, and once callus is formed the cuttings appear to be beyond the risk of damage by the fungus. Coarser leaf mould, which is less rotted down, is now being used in an endeavour to give the mixture the consistency of the peat-moss. Well rotted leaf mould packs rapidly and thus prevents the passage of air so necessary in a rooting material and causes it to become easily waterlogged.

CUTTINGS.

In the main, soft wood cuttings have been used. Only in exceptional cases, where it has been impossible to get soft wood cuttings, have hard wood cuttings been inserted.

The most suitable type of soft wood cutting is rarely obtainable on mature (single stem) trees, but a certain percentage of rooting is still being obtained from this type which is generally elongated and slightly chlorotic. The percentage of rooting of soft wood cuttings has been very low this year. This is mainly due to the fungus disease.

A large number of rooted cuttings have been planted out and many have made very satisfactory progress. There are noticeable differences in the rooting properties and growth between different clones, some rooting proportionately quickly, and others rooting slowly and remaining stationary for a long period after rooting.

GRAFTING.

Early in the year an effort was made to graft primaries of mature trees on the station with scions from laterals from the selected trees on the estates in an endeavour to get flower of the different selections altogether. These grafts were not successful but a small percentage of the same laterals grafted on to the terminal stem of young seedlings were successful. This work will have to be persevered with to simplify hybridization.

Very little other grafting has been done owing to a lack of stock material. Grafts of scion material from some of the parent trees of the hybrids and selections of the Geneticist at Amani were grafted on to the seedling material of Bourbon coffee in the nursery late in 1936 and the successful grafts were planted out this year and are making good progress.

GENERAL NURSERY WORK.

Seed of various potential shade trees was germinated and planted out.

The hot dry period towards the end of 1936 continued, making watering necessary for most small coffee until the long rains commenced in April. Grafts and buds, suffered particularly from this cause and had they not been watered it is doubtful if the plants would ever have made satisfactory trees even if they had not died. Those with *C. robusta* as stocks and scions, particularly those with this species as a stock, suffer more than *C. arabica* in this respect.

Lyamungu,
March 1938.

C. B. Gibbins
Agricultural Assistant

During the period April to November the Chief Scientific Officer carried on the work and a considerable number of young trees were layered in order to provide cuttings for the production of clonal (and presumably more uniform) plants for field experiments. About 600 of these cuttings were successfully rooted as were a further 400 from introduced coffees. Most of this rooting took place in the cool wet season, the average time taken was eighteen weeks.

Two experiments were carried out with Hortomone A, a root-growth promoting substance. Treatments were nil, half, normal (320 to one) and one and a half strengths of a solution as recommended by the makers. The experiments were in the form of four by four latin squares. Each plot contained one representative of each of ten and twelve different trees respectively. The treatments were not significant, but there were indications that Hortomone A accelerated rooting.

There is strong suspicion that the difference between capacity to root of different trees is greater than the general response to root promoting substances.

Control of conditions in the cases such as humidity and temperature favourable to rooting, but unfavourable to certain fungus diseases in the hot dry weather is not yet understood. Close technical supervision is still required.

S. M. Gilbert
Chief Scientific Officer

Section V.

Improvement of Growing Conditions.

(a) *Technique of Field Experiments.*—As a result of study of data from four years' uniformity trials the following knowledge as to technique for field experiments on *Coffea arabica* has been obtained:—

(1) A convenient size of plot consists of 20 trees (normal spacing 9ft by 9ft square).

(2) The latin square of 6 by 6 plots is an efficient layout, as is the method of randomized blocks if repeated at least eight times. The 4 by 4 latin square by itself is inefficient, not being sufficiently sensitive.

(3) Owing to the irregular periodicity of yields of neighbouring trees, from year to year, preferably three years' natural yields of plots should be obtained before treatments are applied.

(4) Means of three years' natural yields give a substantially lower plot error.

(5) Repetition of an experiment over several localities and over several seasons is essential in the absence of conditions suitable to the use of co-variance in order to demonstrate differences due to treatments of the order of twenty-five per cent.

(6) Under the topographical and climatic conditions of northern Tanganyika Territory replications of similar experiments must be grouped in relatively small localities otherwise interaction between locality and season is such as to render combination of the results of experiments as a means of increasing precision, illegitimate, mean plot yields being significantly different between experiments.

(7) Two years' experimental results are not sufficient to show up reasonable significant differences due to treatments.

(8) A period of four years is insufficient to demonstrate appreciable benefits from the method of co-variance.

(9) The exceptional heavy rains of the last two years of the period have overridden any benefits due to treatments as compared with the first two years of natural yields and therefore Cheesman's suggestion of analysis of the differences between pairs of years of natural yields and experimental yields is not possible.

Table VII summarizes the data from individual tree yields. This year those blocks on which treatments have been applied are omitted.

Table VII.

Estate	Year	Number of trees	Mean yield in Kg. of cherry per tree	Standard deviation	Coefficient of variation percentage
A	1934/5	593	0·36	0·54	148·6
	1935/6	593	1·42	1·27	89·6
	1936/7	644	0·88	0·89	101·2
	1937/8	crop failed	—	—	—
D	1934/5	780	1·32	0·86	65·1
	1935/6	780	2·22	0·98	44·2
	1936/7	780	1·24	1·50	120·6
	1937/8	780	3·48	2·00	57·4
G	1934/5	246	2·92	2·68	91·7
	1935/6	246	4·08	2·79	68·4
	1936/7	246	1·22	1·43	117·0
	1937/8	246	1·30	1·31	100·5
H	1934/5	255	6·48	4·91	75·8
	1935/6	255	1·90	1·94	102·4
	1936/7	255	3·60	2·71	75·5
	1937/8	255	2·57	3·08	119·8
I	1934/5	517	5·28	3·81	72·2
	1935/6	517	0·99	1·25	125·7
	1936/7	517	4·00	2·48	62·0
	1937/8	517	0·54	0·91	169·5

TABLE VII.—(*contd.*)

Estate	Year	Number of trees	Mean yield in Kg. of cherry per tree	Standard deviation	Coefficient of variation percentage
J	1934/5	797	4·11	3·51	85·4
	1935/6	797	1·60	1·86	116·2
	1936/7	390	2·32	2·10	90·6
	1937/8	390	4·30	3·01	69·9
N	1934/5	241	11·81	6·05	51·2
	1935/6	241	1·81	2·32	128·2
	1936/7	241	5·63	4·52	80·2
	1937/8	241	3·42	3·46	101·2
Q	1934/5	Not recorded		—	—
	1935/6	319	2·71	2·22	81·8
	1936/7	319	1·51	1·82	120·0
	1937/8	319	3·67	2·45	66·7
R	1934/5	Not recorded		—	—
	1935/6	100	5·55	5·62	101·2
	1936/7	100	5·73	5·11	89·2
	1937/8	100	3·95	5·56	141·0
S	1934/5	Not recorded		—	—
	1935/6	118	2·53	2·65	104·6
	1936/7	118	Crop failed	—	—
	1937/8	118	,,	—	—
T	1934/5	Not recorded		—	—
	1935/6	684	2·13	1·16	54·8
	1936/7	684	0·41	0·44	107·9
	1937/8	684	?	?	—
		Additional estates recorded in 1937/38			
U	1937/8	900	6·98	3·29	47·1
W	1937/8	900	2·52	1·85	73·6
X	1937/8	355	4·21	3·27	77·6
Y	1937/8	792	2·86	2·02	70·7
Z	1937/8	900	1·63	1·22	74·6
AA	1937/8	1,024	1·76	0·99	56·2
AB	1937/8	250	4·88	2·44	50·0
AC	1937/8	209	5·24	4·15	79·2
AF	1937/8	900	5·04	2·73	54·2
AG	1937/8	900	3·46	2·69	77·6

Table VIII shows the yields per acre for all blocks recorded, allowing for "out-turn" and spacing.

TABLE VIII.

Yield of Clean Coffee per Acre of all Uniformity Trial Plots, in Cwts.
(Four years 1934-37).

Estate	1934/5	1935/6	1936/7	1937/8	Average for four years
A	2·0	7·9	6·9	Crop failed	4·2
B	1·2	7·6	7·7	6·9	5·8
C	5·7	2·8	2·2	Crop failed	2·7
D	3·1	5·1	2·9	6·4	4·4
E	0·9	11·2	7·8	5·4	6·3
F	4·8	5·7	4·2	3·1	4·4
G	6·0	8·3	2·6	2·4	4·8
H	19·0	3·7	7·1	4·4	8·5
I	10·9	1·5	7·4	0·5	5·1
J	4·2	1·5	2·9	5·0	3·4
K	7·5	Crop failed	4·8	1·0	3·3
L	9·9	8·3	3·7	6·1	7·0
M	8·9	0·6	5·4	Crop failed	3·7
N	22·8	3·3	11·9	6·5	11·1
O	0·2	4·2	0·8	3·0	2·0
P	5·5	8·4	3·2	4·2	5·3
Q	Not recorded	7·3	4·5	9·0	6·9
R	,,	12·7	13·5	7·6	11·3
S	,,	3·8	Crop failed	—	1·3
T	,,	2·4	0·5	Crop failed	1·0
U	Not recorded	—	—	12·2	12·2
W	,,	—	—	4·7	4·7
X	,,	—	—	9·5	9·5
Y	,,	—	—	5·0	5·0
Z	,,	—	—	2·1	2·1
AA	,,	—	—	4·1	4·1
AB	,,	—	—	9·1	9·1
AC	,,	—	—	9·8	9·8
AF	,,	—	—	6·2	6·2
AG	,,	—	—	6·2	6·2

Average of all estates for four years 5·3 hundredweights an acre.

Table IX gives the frequency classes in kilogrammes of cherry for the best, medium and worst estates over four years.

Table IX.

FREQUENCY

Kg. of Cherry	Best				Medium				Worst			
	1934	1935	1936	1937	1934	1935	1936	1937	1934	1935	1936	1937
— 1	309	75	110	81	136	101	417	154	726	266	603	323
— 2	156	26	102	61	70	128	114	103	8	219	148	283
— 3	65	22	108	81	68	125	67	106	2	119	12	128
— 4	23	52	132	109	81	134	36	101	—	71	1	27
— 5	11	77	99	113	79	71	30	84	—	38	—	3
— 6	5	116	90	99	81	61	19	65	—	19	—	—
— 7	1	132	58	83	55	44	12	50	—	12	—	—
— 8	1	97	38	67	50	26	10	23	—	3	—	—
— 9	—	78	23	39	33	14	3	18	—	1	—	—
— 10	—	35	6	23	12	5	4	8	736	748	764	764
— 11	—	21	7	11	9	1	4	1				
— 12	—	11	2	6	6	—	—	—				
— 13	—	3	1	2	1	1	—	3				
— 14	—	—	1	3	681	711	716	716				
— 15	—	5	—	—								
— 16	—	—	1	—								
	571	750	778	778								

(b) *Experiments on Estates.*—1936 series. In the 1936 report details were given of a series of four estates on which, having obtained two years' natural yields, treatments were first applied in that year. With the completion of two years' harvest of experimental yields it was expected that definite results would have been obtained. This, disappointingly, is not the case. None of the treatments have given results which can be said with certainty are not influenced by other causes. Usually in agricultural experiments if the chances are shown to be 20 to 1 (P=·05) that the differences in yield are due to treatments the results are accepted, but in all four experiments the odds are less than this.

Actually the mean yields of treatments for the pair of experiment years are, in most cases, less than those of the untreated years. It is thus shown how great an effect abnormal climate has on the very variable coffee available, having overridden treatment effects completely.

The plot yields in kilogrammes are tabulated on page 21. Too much must not be read into the results as some of the effects are undoubtedly due to position in the field.

Graph II

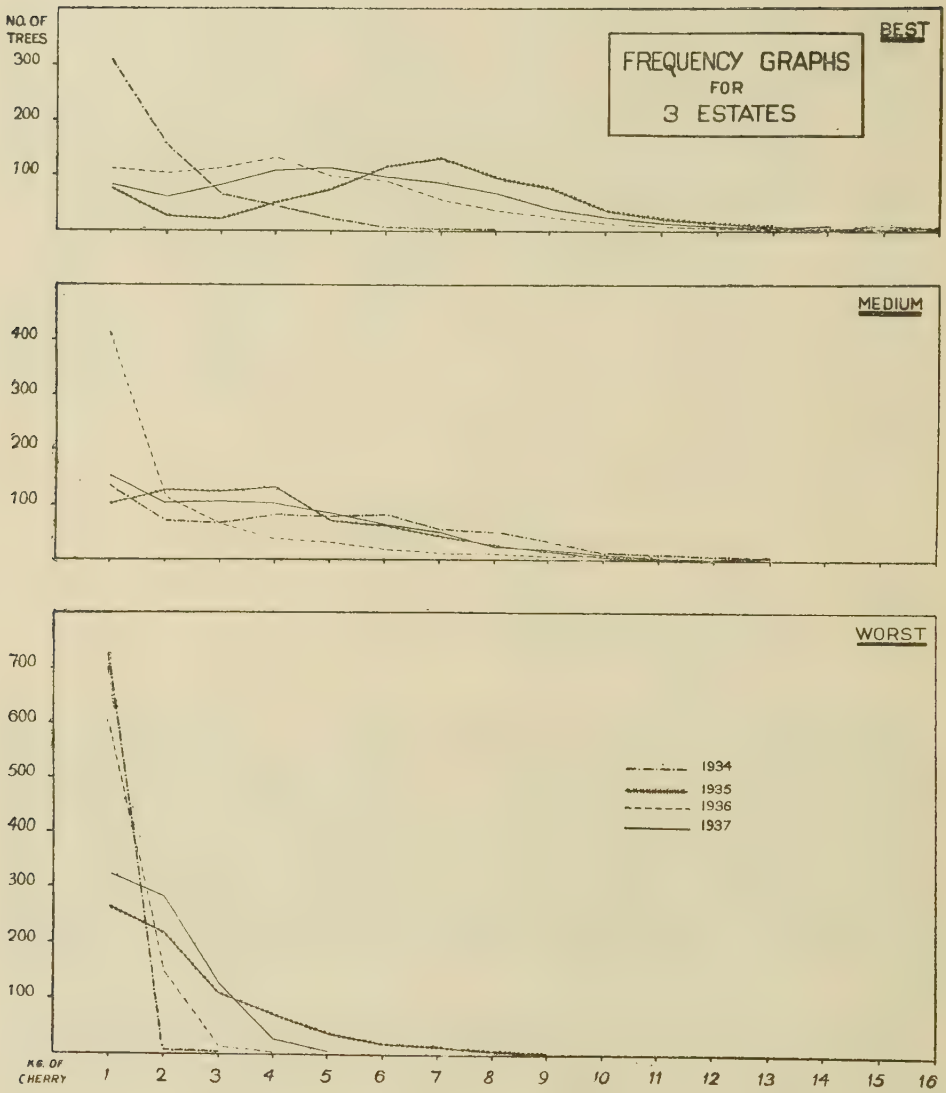

NO. OF TREES
BEST
FREQUENCY GRAPHS
FOR
3 ESTATES
300
200
100
MEDIUM
400
300
200
100
WORST
700
600
500
400
300
200
100
1934
1935
1936
1937
NO. OF CHERRY
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

Table X.

Total plot yields of three estates for four years in kilogrammes (20 tree plots).

Estate	Year	Treatments			
		Nil	Nil	Nil	Nil
	1934	244	233	297	245
	1935	266	356	344	330
F ...	Mean	255·0	294·5	320·5	287·5
		Nil	Sulphate of ammonia	Pen manure	Mulch (grass unnamed)
	1936	192	220	240	266
	1937	180	321	244	182
	Mean	186·0	270·5	242·0	224·0
Difference between pair of years ...		— 69	— 24	— 78·5	— 63·5
		Nil	Nil	Nil	Nil
	1934	287	249	271	256
	1935	211	215	248	205
L	Mean	249·0	232·0	259·5	230·5
		Nil	Sulphate of ammonia	Pen manure	Mulch (banana)
	1936	101	80	105	117
	1937	246	264	227	236
	Mean	173·5	172·0	166·0	176·5
Difference between pair of years ...		— 75·5	— 60	— 93·5	— 54
		Nil	Nil	Nil	Nil
	1934	8	8	3	13
	1935	111	160	130	170
O	Mean	59·5	84·0	66·5	91·5
		Nil	Sulphate of ammonia	Pen manure	Mulch (guinea grass)
	1936	38	41	45	39
	1937	101	122	97	79
	Mean	69·5	81·5	71·0	59·0
Difference between pair of years ...		10	— 2·5	4·5	— 32·5

TABLE X.—(*contd.*)

Estate	Year	Treatments			
		Nil	Nil	Nil	Nil
	1934	86	70	74	98
	1935	449	431	434	488
B	Mean	267·5	250·5	254·0	293·0
		Nil	Sulphate of ammonia	Compost	Mulch (guinea grass)
	1936	313	297	301	360 (Elephant grass)
	1937	367	352	466	352
	Mean	340·0	324·5	383·5	356·0
Difference between pair of years ...		+ 72·5	+ 74·0	+ 129·5	+ 63·0

Many useful indications have come to light in regard to the effect of treatments, but more than two seasons' yields are required before recommendations can be formulated.

Six estates have, however, consented to carry out, beginning in 1938, experiments so designed to show up twenty-five per cent differences in yield, using the most likely treatments as indicated in the 1934-37 series under discussion. Plots, as a result of improvements in experiment technique learned from "uniformity trials," will be replicated ten times on each estate.

One of the strongest indications of economic value is the soundness of application of sulphate of ammonia towards the end of the long rains particularly in very wet years. Mulch of banana trash and slow decaying grasses also give good promise especially in dry years. Grasses rich in nitrogen such as guinea grass appear to have a harmful effect.

In the areas of exceptionally heavy rainfall in 1937 sulphate of ammonia has considerably improved the "out-turn" both of clean coffee to cherry and of percentage of grade "A's". Conversely it has lowered the percentage of peaberries. It thus appears that in seasons of heavy rainfall causing probably serious leaching of nitrates and delay in recommencement of nitrification the coffee bush has not sufficient nitrogen available to enable the cherry to develop two normal beans and the result, conspicuous in 1937 on Kilimanjaro, is many empty cherries and a higher percentage of peaberry resulting in a considerable fall in yield. A study of the figures in tables X and XI brings this out clearly.

TABLE XI.

Estate		NIL	Sulphate of ammonia	Pen manure	Mulch
F	Cherry yield Kg. ...	180	321	244	182
	Clean—cherry	14·7	16·0	13·8	14·6
	Peaberry	14·5	11·7	16·0	15·9
	Grade A	85·6	87·1	87·0	86·2
	Bold	22·2	28·2	30·3	20·6
L	Cherry yield Kg. ...	246	264	227	236
	Clean—cherry	17·2	16·6	16·8	16·4
	Peaberry	6·0	5·3	6·1	5·4
	Grade A	72·4	75·4	74·0	71·1
	Bold	7·7	5·3	7·0	6·0
O	Cherry yield Kg. ...	101	122	97	79
	Clean—cherry	16·0	15·1	15·8	15·7
	Peaberry	9·3	9·0	10·2	9·0
	Grade A	29·0	31·5	26·2	32·6
	Bold	1·8	2·0	1·8	2·6

In regard to the experiments on which treatments were to be applied in 1937 (*see* page 58 of 1936 report) the following note may be of value in helping planters to appreciate the difficulties that are met in work of this nature. Of the twelve estates that were to be used for experiments:—

(a) On one the coffee was abandoned as a crop.

(b) On two the crop failed.

(c) One was badly neglected through unforeseen circumstances.

(d) On one the application of treatments was postponed to suit the convenience of the planter.

(e) On two the work was spoilt by the inability of the planter to protect the block.

Thus over 50 per cent of the 1937 programme on estates has been cut out through causes not under our control.

In the case of the pruning experiment the operations were commenced in November, too late to give results this year.

Lyamungu,
March 1938.

S. M. GILBERT
Chief Scientific Officer

STATION.

General.

A general review of the climatic conditions pertaining during the four planting seasons since the commencement (1934) of the station and their effect on the practice employed in establishing coffee is of interest. The normal time for planting coffee in the field is the period April, May or June, coinciding with the big rains.

In the seasons 1934 and 1935 only was it possible to establish young coffee without the aid of irrigation. It is a significant fact that in each of those seasons the rainfall of April-May was much less than that of the corresponding period in the subsequent seasons. It would appear that the seasons of lighter rainfall allowed of appreciable growth immediately on planting whereas during those seasons of exceptionally heavy rainfall soil conditions at planting time were not conducive to growth. Consequently in the case of young coffee planted in seasons of exceptionally heavy rainfall the plants do not become sufficiently established to withstand the drier months of August, September and October. The reason for this is probably the fact that in seasons of heavy rainfall in April-May considerable leaching of nutrients occurs and also the lower soil temperatures will limit the production of nutrients. Application of Sulphate of Ammonia immediately after the cessation of the rains has proved efficacious but sufficient root growth has not occurred to limit the possibilities of severe droughting under even slightly adverse conditions.

Irrigation on slopes such as are found on this station is a dangerous practice and water, besides being limited, cannot reach all parts of the estate. Consequently it is considered that to maintain soil moisture a system of mulching of all new planting will have to be adopted, particularly in experiments where supplying is most undesirable owing to the introduction of the age factor.

With the object of supplying material for mulching, swamps and other places have been planted up with elephant grass or bananas. Approximately three acres of elephant grass and two and half acres of bananas have been planted up to the present. Arrangements have been made for the partial composting of the elephant grass under the cattle prior to application, this will be done on the site. It is intended to extend these areas.

The climatic conditions existing during the months January, February and March 1937, were hot and dry and conducive to severe damage to the coffee by thrips: April and May were months of very heavy rain with the effects on young coffee described above: subsequent to August light but effective rain fell each month and the young coffee grew rapidly. On the older coffee the effect of rain in the months subsequent to August was to encourage vegetative growth and delay flowering.

PESTS AND DISEASES.

Thrips occurred in all unshaded areas in January or February 1937. These outbreaks were controlled effectively with lime sulphur. Routine Bordeaux spraying against Hemileia was done in March 1937.

A condition of young primaries and secondaries resembling a form of die-back occurred in February and March 1937. So far it has not been identified with any fungus or pest. The condition has occurred again in February 1938 and is confined to one type of coffee, a selection within Blue Mountain. This condition is being investigated by the Plant Pathologist.

Cercospora coffeicola did severe damage to the leaves of young coffee in June and July 1937. Capsid did a small amount of damage to flower bud in November 1937.

COMPOST.

Approximately forty tons of compost have been manufactured during the year.

Experiments and Demonstrations on the Station.

Experiment I—Planted 1935.—(*See* 1936 report for details).

(a) *Project.*—To test the effect on subsequent growth of seven different methods of planting.

Potentially there is a heavy crop on the majority of trees in this experiment. A small proportion of the flower bud only has opened and set, while the remaining flower bud awaits suitable climatic conditions to cause opening and setting. Girth measurements have been taken in 1937.

Experiment IV—Planted 1936.—(*See* 1936 report for details).

The following varieties were removed and planted in the forest owing to their inability to stand the existing conditions: *Eugenoides*, *Stenophylla* and *Mufindiensis*.

Within the *Arabica* group there is no one variety or type which shows outstanding vigour when compared with Kent's local. Of the *Robusta* group all varieties and types with the exception of *Excelsa* show signs of scorch and dieback during the hot months. *Excelsa* shows a certain degree of yellowing, the absence of dieback may continue only so long as there is no growth of primaries.

Shade consisting of *Albizzia maranguensis*, *Cordia holstii* and *Acrocarpus fraxinifolius* was planted in May 1937.

Experiment VIII.—Soil erosion demonstration.

The demonstration consists of a series of eight adjacent plots each 100ft (down the slope) by 14ft 9in., or approximately one-thirtieth of an acre, on a uniform slope of 1 : 6. The land was in heavy bush up to March 1934. The soil is classified as a tropical red earth, partially laterized, the field texture is that of a clay loam with a fairly high moisture retaining capacity. The sub-soil is a deep, freely drained, chocolate-red clay, friable throughout the profile.

The plots are separated along their length and closed at the top by concrete blocks sunk into the soil and protruding three to four inches above the general soil surface. At the bottom of each plot there is a concrete tank in which the eroded soil and run-off water are collected.

The treatments, which were commenced on the 21st April 1934 and may be considered to have been effective by the 1st February 1935 are as follows:—

Plot 1—Control (no treatment).

Plot 2—Contour hedge on ridge (1935 and 1936 ridges 32ft apart and in 1937 ridges 16ft apart).

In view of the observations on soil moisture contents in time of drought the treatment was modified on plot 2 in January 1937, the frequency of the contour ridges was doubled and no hedge plant sown.

„ 3—Control (no treatment).

„ 4—Contour hedge on ridges and procumbent cover crop (ridges 32ft apart).

„ 5—Control (no treatment). From January 1937 onwards this plot was mulched with banana trash.

„ 6—Cover crop (procumbent).

„ 7—Erect cover crop.

„ 8—Control (no treatment).

All plots were planted with coffee at a spacing of 9ft by 9ft on the 30th April 1934. Up to December 1935 the controls were kept clean weeded, the weeds being left on the surface. Plot 2 was weeded when the weeds reached flowering stage. In 1935 and 1936 the plots having contour hedges (2 and 4) had three hedges of *Crotalaria* spp. in each case; the hedges were on ridges 32ft apart, the lowest being two feet above the concrete tank. The procumbent cover crop used was *Dolichos hosei*; the mixed erect cover crop consisted of *Crotalaria* spp. and *Canavalia ensiformis*.

From January 1936 onwards modifications were introduced in certain instances, in two of the control plots, Nos. 3 and 8, the weeds were placed in rows across the slope, in January 1937 control plot No. 5 was mulched with banana trash and on plot No. 2 additional contour ridges, making the ridges 16ft apart were thrown up and no hedge plant sown.

Prior to the big rains in both 1935 and 1936 the following treatments were given:—

(a) Each tree in each plot was envelope forked.

(b) Control plots (1, 3, 5 and 8) were *jembe* forked from top to bottom.

(c) Contour hedge plot (2) was treated as those in (b).

(d) Contour hedge and procumbent cover crop (4) and procumbent cover crop (6) and mixed erect cover crop (7) plots were envelope forked over the whole of their area.

Other than routine weeding no cultural treatment was given to any of the plots immediately prior to the big rains of 1937.

Table XII gives the actual weight of dry soil lost in the years 1935, 1936 and 1937 in tons per acre. These amounts are also expressed as percentages of the top foot soil.

TABLE XII.

Plot No.	Plot each 1/30 acre	Loss per acre in tons (dry soil)			Expressed as a percentage of top foot of soil		
		1935	1936	1937	1935	1936	1937
8	Control	18·55	16·2	20·4	1·27	1·11	1·41
3	,, ...	8·34	21·6	20·4	0·57	1·48	1·41
1	,, ...	10·90	32·4	33·6	0·75	2·22	2·29
5	,, (mulched in 1937) ...	14·10	28·8	Nil	0·967	1·97	Nil
2	Crotalaria hedge on contour ridge 32ft apart in 1935 and 1936	0·86	5·4	—	0·059	0·37	—
	In 1937 contour ridge only. No hedge plant			Nil			
4	Crotalaria hedge on contour ridge and cover crop. Hedges 32ft apart	0·08	0·4	Nil	0·0055	0·03	—
6	Cover crop, procumbent ...	0·174	0·3	Nil	0·0114	0·02	—
7	Cover crop, erect, Crotalaria and Canavalia	0·174	6·0	Nil	0·0114	0·41	—

From table XII it is seen that the anti-erosion measures on each of the treated plots were entirely effective in 1937. The control plot (5) which was banana mulched in January 1937 also showed no loss of soil during the rainy season of 1937.

The average loss of soil in tons per acre from the controls and treatments for each of the three years are:—

	1935		1936		1937
Controls	13·0	...	25·0	...	25·0
Treatments	0·32	...	3·0	...	—

There is thus a total average loss for the three years of sixty-three tons of soil from the controls and 3·3 tons from the treatments.

Table XIII gives the rainfall for the periods of the big rains of 1935, 1936 and 1937.

Table XIII.

Rainfall for 1935, 1936 and 1937 (Millimetres).

Date	February			March			April			May			June			July		
	1935	1936	1937	1935	1936	1937	1935	1936	1937	1935	1936	1937	1935	1936	1937	1935	1936	1937
1	—	—	—	4·7	—	1·9	—	11·1	54·0	30·0	18·8	4·8	7·9	—	17·4	7·8	—	2·1
2	—	—	0·7	—	—	11·0	30·4	—	2·5	69·7	34·7	33·2	19·0	18·4	15·8	4·4	0·3	—
3	—	—	—	8·9	—	18·2	20·4	—	10·0	39·4	6·8	26·9	2·0	—	4·9	—	0·6	0·2
4	0·1	—	—	7·6	0·4	4·8	0·25	14·3	3·1	7·8	112·7	97·1	—	—	0·1	—	29·9	—
5	17·2	—	—	—	—	—	0·3	0·2	1·7	21·6	104·3	7·6	1·0	—	—	2·3	13·5	—
6	1·2	—	—	0·5	—	15·3	13·6	25·2	7·1	120·0	0·7	50·2	0·6	—	32·6	0·6	0·4	—
7	0·5	—	—	—	8·8	—	0·5	9·3	115·7	33·7	8·0	24·2	2·0	7·8	14·4	1·7	2·6	0·5
8	3·4	—	—	21·7	4·4	—	2·3	12·6	62·6	74·0	36·5	19·3	—	18·7	8·1	1·2	3·5	—
9	—	—	—	4·5	13·6	—	9·3	2·7	43·5	21·5	27·4	20·5	—	3·5	0·4	—	3·3	—
10	3·25	—	—	6·6	—	—	0·6	46·7	2·6	53·0	6·5	76·1	—	1·4	0·8	7·2	1·0	10·2
11	—	—	—	6·8	—	—	—	38·1	20·7	35·7	11·9	180·5	0·1	—	0·4	2·0	8·1	2·7
12	0·75	—	—	5·5	—	0·4	5·5	17·8	3·9	9·0	35·6	68·5	8·3	9·2	11·0	0·2	—	1·6
13	2·8	—	—	12·9	0·6	5·1	104·0	2·1	85·5	2·6	23·5	41·9	6·1	46·8	2·6	—	—	4·0
14	—	—	—	—	17·4	7·2	10·8	9·7	89·6	—	31·3	114·1	8·1	36·5	1·0	—	—	4·5
15	—	3·8	—	2·4	3·3	5·1	3·7	19·2	36·8	—	3·5	0·9	—	—	2·5	—	—	1·6
16	—	39·3	—	—	—	—	—	41·4	9·2	0·8	7·8	11·5	—	2·6	0·5	0·5	—	1·8
17	—	0·1	—	—	3·0	2·0	1·0	68·4	29·0	1·1	17·6	9·8	0·8	1·8	0·6	—	0·6	1·6
18	—	27·9	—	0·5	—	—	0·6	120·8	31·0	1·4	2·8	2·3	13·5	5·1	0·7	—	3·4	—
19	—	13·3	—	—	—	6·6	16·3	40·0	5·6	25·5	48·0	14·3	6·6	1·8	5·0	—	2·8	—
20	45·75	—	—	18·1	—	—	1·25	22·8	115·2	25·7	49·5	3·9	—	1·6	13·5	—	3·0	0·3
21	87·0	—	—	3·6	0·8	—	—	44·2	96·5	2·0	2·5	13·3	0·4	3·9	8·1	0·1	9·8	—
22	1·5	13·1	—	—	—	—	—	16·4	11·5	24·1	4·0	10·4	—	1·0	0·2	—	22·5	—
23	—	7·5	—	—	0·5	—	—	0·8	0·1	18·3	—	—	—	3·0	0·2	2·5	—	—
24	31·0	18·6	—	0·5	—	—	1·5	—	1·6	22·8	—	6·4	—	4·8	—	4·5	0·8	9·2
25	32·0	1·2	—	2·2	4·0	—	0·3	22·7	1·2	7·8	3·0	—	—	9·0	—	—	0·6	—
26	—	2·1	0·1	5·5	1·1	—	16·2	31·5	2·0	70·8	0·9	—	4·5	0·2	—	—	—	—
27	6·9	8·1	2·5	—	—	—	47·3	20·5	0·6	10·0	25·0	—	11·3	12·9	3·4	—	—	—
28	—	0·1	—	—	—	5·4	34·5	31·7	54·7	0·4	23·0	—	41·0	25·0	6·1	—	—	—
29	—	—	—	—	—	32·3	2·8	29·9	47·0	—	22·8	—	0·2	7·0	1·5	—	—	—
30	—	—	—	0·5	—	19·6	29·0	52·4	1·1	1·6	5·4	—	—	—	1·3	4·8	—	—
31	—	—	—	—	—	105·0	—	—	—	0·5	0·9	1·8	—	—	—	4·0	—	—
Total ...	233·85	135·1	3·3	113·0	57·9	239·9	352·4	752·5	945·6	730·8	675·4	839·5	133·4	222·0	153·1	43·8	106·7	31·3

Table XIV gives the run-off in gallons per acre for the seasons 1935, 1936 and 1937 respectively at various dates. It will be seen that the rate of run-off per acre in 1936 from the controls was 114,000 compared with 37,000 gallons from the treatments. In 1937 the average rate of run-off in gallons per acre from the controls was 96,300 and that from the treatments 30,200 gallons.

TABLE XIV.

Run-off in Gallons per Acre.

Date	Plots								Rain total mm.	Intensity
	8	3	1	5	2	4	6	7		
12-13.4.35	2,940	2,460	1,560	2,610	1,560	1,440	1,740	2,040	104	76mm. in one hour
3-7.5.35	4,620	5,520	6,240	4,560	3,420	—	1,320	2,520	142·6	—
9-10.4.36	1,440	1,320	960	3,240	920	720	840	1,080	50	20mm. in one hour
17-18.4.36	*15,840	11,160	*15,840	*16,320	11,400	4,200	4,560	8,100	125	50mm. in one hour
18-19.5.36	3,480	4,560	5,760	*14,280	1,440	660	540	1,320	43	20mm. in one hour
12-13.6.36	2,940	300	3,780	2,400	420	420	480	240	47	12mm. in one hour
6-7.4.37	*14,520	*14,280	*15,360	3,720	4,620	4,260	3,780	4,320	108	40mm. in one hour
13-14.4.37	*16,080	*16,080	*15,840	4,080	5,280	4,440	4,260	7,680	91	48mm. in one hour
19-20.4.37	*11,760	*13,740	*15,060	7,320	6,240	5,580	9,540	11,100	120	50mm. in one hour
27-28.4.37	*20,160	*20,160	*18,900	2,640	3,000	3,360	3,000	5,700	82	60mm. in one hour
3-4.5.37	*16,080	*16,080	*15,840	2,640	3,300	3,540	2,700	4,200	99	25mm. in one hour
10-11.5.37	*16,080	*16,080	*15,840	5,400	6,600	5,760	5,280	7,320	182	Average for 24 hours 7·6mm. per hour

*Tank overflowed.

It will not be out of place here to note the effectiveness of two other anti-erosion measures employed under comparable conditions. The remarks are based on observations only, and no figures as to actual losses or otherwise are available.

(a) *Terracing.*—From terraces on the slope adjoining the erosion demonstration no appreciable erosion occurred. A certain amount of soil was washed from the bank of each terrace to the terrace below only.

(b) *Box Ridging.*—So long as the lower side of the "box" is on the contour box ridging is effective; if otherwise, water is concentrated at the lowest point and breaks through.

Before drawing any conclusions as to the method to be employed to prevent erosion, other factors have to be considered. Firstly, the effect of any anti-erosion measure on the growing coffee, and secondly, whether such measures are economic.

(a) *Effect on Soil Moisture.*—After a two months' drought in 1936 the soil moisture content at 15 inches was ascertained on each of the demonstration plots, and it was found that the soil moisture content of the controls was

significantly higher than that of any of the treatments,—this fact was reflected in the condition of the coffee, the coffee in the control plots being in much better condition, and with considerably more leafage than that in the treated plots. It should be added that the soil moisture content at a similar depth on adjacent terraces was significantly higher than that of the treated plots but not that of the controls. Thus on the grounds of the adverse effect in soil moisture in time of drought alternative treatments to—

(i) Contour ridge and hedge plant;

(ii) Contour ridge and procumbent cover crop;

(iii) Procumbent cover crop; and

(iv) Erect cover crop;

have to be considered.

Banana mulching, on the other hand, has been shown to keep the soil moisture of the top foot of soil at a level 12 per cent higher than that of the bare soil. These determinations were made at the end of a three months' drought.

COST.

(1) *Contour Ridging.*—From the experience this year in the contour ridged plot of the demonstration, ridges at every 1–1½ft vertically are effective on a 1 : 6 slope under the conditions of the demonstration. The ridges are one foot high and two feet at the base. On slopes of less than 1 : 6 the ridging is effective provided the superficial distance between them is not more than 20ft. The cost of contour ridging varies with the degree of slope—a slope of 1 : 6 cost Shs 4/- to Shs 5/- per acre initially and upkeep of about Shs 2/- per annum. Contour ridges at 20ft apart superficially will cost initially Shs 2/- per acre and Sh. 1/- to Shs 1/50 upkeep.

(2) *Banana Mulching.*—This method is entirely effective against erosion. Its cost is in the neighbourhood of Shs 120/- per acre in young coffee if the mulch has to be purchased. In older coffee the cost would probably be Shs 60/-.

(3) *Terracing.*—The cost of terracing is between Shs 20/- and Shs 25/- per acre and Sh. 1/- per acre per annum upkeep.

(4) *Box Ridging.*—From an anti-erosion point of view, has no advantages over contour ridging and is more costly. The results may be summarized:—

(a) The following treatments were effective anti-erosion measures under the conditions of, or similar to, the demonstration plots.

1. Contour ridges at 1–1½ft vertically between the ridges.
2. Crotalaria hedge on contour and cover crop.
3. Cover crop (procumbent).
4. Erect cover crop.
5. Banana mulch.
6. Terracing.
7. Box ridging, provided the lower side of the box is on the contour.

(b) Of the above, the following do not affect adversely soil moisture during periods of drought.

1. Contour ridges only.
2. Banana mulch.
3. Terracing.
4. Box ridging.

The conclusions which may be drawn are that, under the conditions existing at this station, anti-erosion measures are necessary, and that contour ridging is the cheapest effective anti-erosion measure in coffee. There appears to be no necessity to terrace on a 1 : 6 slope, and there appears to be no particular advantage in box ridging. Banana mulching is as effective as any anti-erosion measure, having the great advantage over any of the other methods in that it conserves moisture: it remains to be proved whether it is an economic proposition, and experiments are being conducted with this object in view.

Experiment IX.—Cultivation.

(a) *Project.*—To determine the effect of various methods of cultivating coffee.

(b) *Material.*—R.R. 1.

(c) *Layout.*—Five by five latin square.

The following treatments are given at the end of the long rains:—

(1) Fork *jembe*, (2) *jembe*, (3) no cultivation, (4) envelope forking, (5) trenching.

Girth measurements have been taken and there are no significant differences in this respect between the various treatments.

Experiment XI.—Variety Field Trial.

(a) *Project.*—To determine the yielding capacity under the conditions existing at the station of seedling material of each of the following varieties or types of coffee:—

(1) Columnaris.
(2) A selection within Blue Mountain.
(3) Kent's (local seed).
(4) Bourbon (local seed).

(b) *Layout.*—A 4 by 4 latin square. Sixteen trees per plot. This experiment was planted in April 1935. Seedlings of six months' old of Kent's and Bourbon were used and stumps of twelve months' old plants of Columnaris and the selection within Blue Mountain.

Either due to the fact that the selection within Blue Mountain and Columnaris were stumped or that neither are so vigorous as Kent's or Bourbon, the Kent's and Bourbon are much superior. This experiment is to be replanted with clonal material when it is available. Girth measurements have been taken.

Experiment XII.—Planted 1935.

Project.—To investigate the value of seedling selection in the nursery.

From observations on increment growth and volume made in 1935 and 1936 the best nursery selections maintained their position throughout. Measurements of girth at a height of 6in. above ground level in 1937 showed no significant differences between the various classes.

This experiment suffered severely in February and March 1937 from a disease or physiological conditions resulting in dieback of the primaries and young suckers. Twenty-six trees were uprooted and burned when the dieback appeared so severe that recovery was unlikely. The cause of the dieback has not been ascertained so far.

Experiment XIII.—System of Growth Experiment. Planted 1935.

(a) *Project.*—To compare system of training *Coffea arabica* with a view to learning:—

(1) The most economical methods as regards pruning.
(2) The best yielding system.
(3) The effect of the system on factory out-turn.

(b) *Treatments.*—(1) Multiple stem, (2) Agobiada, (3) Single stem.

(c) *Layout.*—Plots of twelve trees. Latin square of 3 by 3 plots repeated three times in different parts of the station. Guard row round each square.

(d) *Material.*—Two year old stumps of Kent's selected for uniformity, especially girth which appears to be correlated with yield.

Shade consisting of *Sesbania punctata* and *Albizzia maranguensis* has been planted.

Difficulty has been experienced in obtaining uniformity of material within the plots. It appears necessary to prepare material in the nursery for the multiple stem system.

The suckering of trees being trained on the Agobiada system has been very poor. With the present experience it would seem advisable to delay bending over the stems until the trees have attained a height of two and a half feet.

Experiment XIV.—Mulch Experiment. Planted 1935.

This experiment, details of which were given in the annual report for 1936, has been continued throughout the year, but in the light of experience as to treatments which are practicable under the conditions in the station, it will be replanted on a different site using clonal material and the treatments will be modified. (These latter are given under Experiment XIVB.)

The coffee in the banana mulch plots remains outstanding, having much stronger growth, good leafage and has set a much larger crop than the coffee in any of the other plots. The nitrate determinations of the various plots appear in the Chemist's report, these figures show that the rate of nitrification under banana mulch after the long rains is more rapid and attains a higher level than that of any other treatment.

The coffee in the banana mulched plot has developed a mass of fibrous roots in the top six inches of soil. One factor in the increased vigour of the coffee of these plots may be that their roots, in being more superficial, pervade a volume of soil in which there is the greatest amount of plant nutrients.

See Graph III for soil temperatures as between mulched and unmulched plots.

Experiment XVII.—Age Experiment. Planted 1937.

(a) *Project.*—To establish coffee of different ages with a view to subsequent study of the effects of this factor on yield and bean qualities with other factors held uniform.

(b) *Layout:*

Randomized blocks repeated eight times.
Plots of 16 trees.
Half plots—Kent's or Bourbon at random.
Seed in each case to be obtained from the same estate block each year.
Shade is being established.

Native Demonstration Holding.—Planted 1937.

The native demonstration holding is 3·3 acres in extent, of which approximately 2·2 acres has an easterly facing and approximately 0·65 acres a westerly facing. These two areas have been planted up with coffee (Bourbon). The area (0·45 acres) in the valley between the two coffee areas has been planted with elephant grass for fodder or mulch purposes.

The demonstration has been planned to show the effects of anti-erosion measures, the value of holing six months prior to planting, and the benefits of controlled shade as opposed to no shade. The shade consists of *Albizzia maranguensis* and bananas.

Two oxen are kept in a shed on the site and the manure made there will be applied to the area. Compost made on the site prior to the planting of the coffee in 1937 was applied to the coffee at planting time.

Plantation Demonstration.

This demonstration consists of three acres. The whole area was contour ridged (one foot vertical intervals) and shade was established prior to planting with coffee in April 1937. The coffee is planted at a spacing of nine feet by nine feet. The contour ridges were planted with *Tephrosia vogellii* as a hedge plant.

The shade trees were planted at a spacing considered likely to give shade to the coffee in its first two to three years in addition to later years, for this purpose both semi-permanent and permanent types were necessary. For the semi-permanent types *Trema guineensis* and *Cordia holstii* were planted alternately within the row at a spacing of 27 feet and between rows at a spacing of 27 feet. *Cordia* is slower in attaining height than *Trema* and it is thought that, as thinning out of shade trees becomes necessary, the *Trema* can be removed and *Cordia* be left to function as shade together with the permanent shade trees.

The permanent shade trees being used are *Albizzia maranguensis* and *Rauwolfia inebriens*. These are planted alternately within the row at a spacing of 27 feet and the rows are alternated with these of semi-permanent shade trees. *Rauwolfia* is again quicker in its growth then *Albizzia maranguensis* and it is possible that, on the removal of *Cordia*, *Rauwolfia* will be effective shade, similarly that ultimately the *Rauwolfia* will be removed and *Albizzia* be left as the permanent shade.

Blocks of both Bourbon and Kent's seedlings (six months old) were planted in the demonstration. In June and July 1937 the coffee in this area suffered severely from *Cercospora coffeicola*.

The shade trees on this demonstration have been pruned to lighten the shade where necessary and in order to get high spreading shade as quickly as possible.

The shade tree collection has been extended. It now contains 52 varieties of possible shade trees.

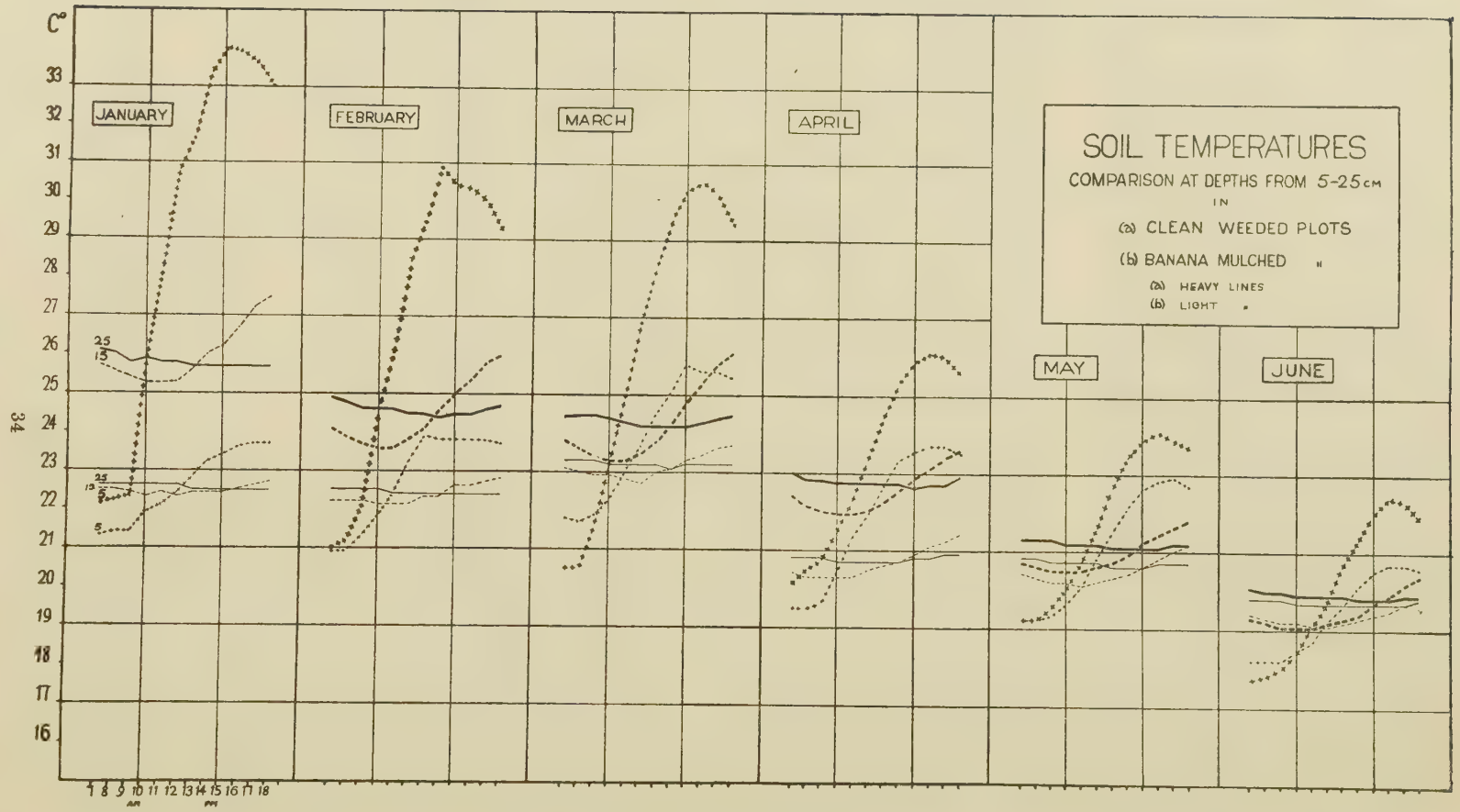
Projected Experiments.

During 1938 the following experiments will be planted:—

Experiment III.—Details.

(a) *Project.*—To compare vegetatively propagated plants of *Coffea arabica* with scions from same mother trees on seedling stocks (same parents) and with seedlings of same descent.

Graph III


C°
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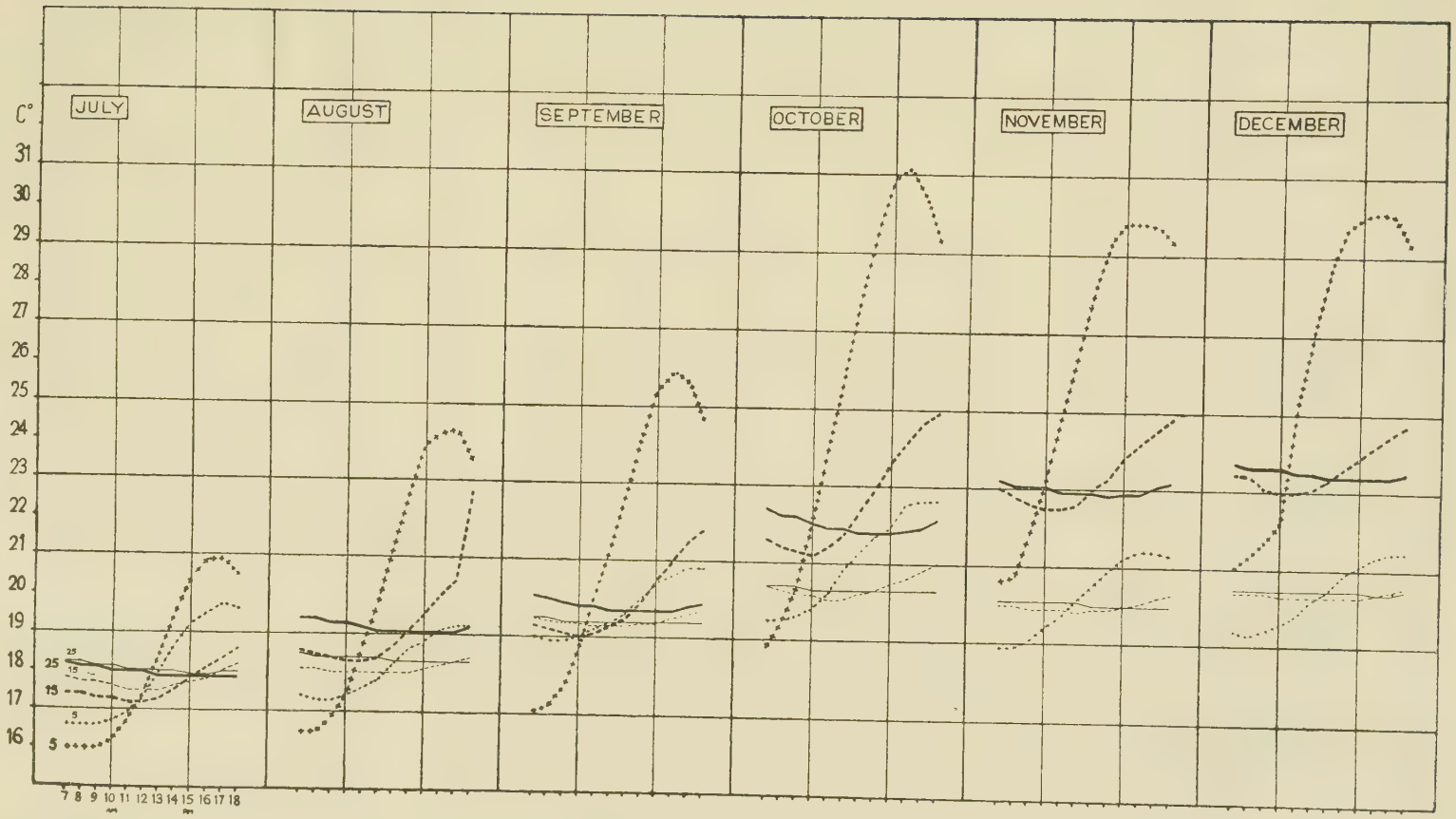
17
16
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
SOIL TEMPERATURES
COMPARISON AT DEPTHS FROM 5-25 cm
IN
(a) CLEAN WEEDED PLOTS
(b) BANANA MULCHED "
(a) HEAVY LINES
(b) LIGHT "
25
15
5
1 8 9 10 11 12 13 14 15 16 17 18
AM
PM


C°
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7 8 9 10 11 12 13 14 15 16 17 18

(b) *Material.*—Five mother trees will be selected—as far as can be told at the time plants of good quality from uniformity trials now being conducted will be taken.

Four types of material will be planted out:—

(1) Scion A on layered and rooted stock A.
(2) Clonal plant A—obtained by layering and rooting.
(3) Scion A on seedling stocks of A.
(4) Seedlings of A.

All above repeated for mothers B, C, D and E Kent's and/or Bourbon.

(c) *Layout.*—4 by 4 latin square. Each plot four by five trees. Trees 9ft by 9ft square each way.

Experiment X.—Shade Experiment. Details.

(a) *Project.*—To study the effect of varying intensities of artificial shade on *Coffea arabica.*

(b) *Treatments:*

(1) No shade.
(2) Light shade—1in. shade—2in. space.
(3) Medium shade—1in. shade—1in. space.
(4) Banana mulch (ground shade).

(c) *Layout.*—4 by 4 latin square. Plots of 3 by 3 trees. Guard rows one tree deep.

(d) *Material.*—Clonal material (Bourbon).

Experiment XIV B.—Details.

(a) *Object.*—To study the effects on Arabica coffee of ground application of locally produced material. Each application is used as a mulch.

(b) *Material.*—Provisional selection from good yielding trees. Each plot to contain one clone (rooted cutting) of 20 mother trees. Position of each clone in any one plot decided by randomization.

(c) *Layout.*—5 by 5 latin square. Single tree guard rows. Mixed shade of *Albizzia* and *Trema.* Each plot 20 trees—5ft by 4ft to 9ft apart square.

(d) *Treatments:*

(1) Control—weeded as necessary and used as mulch.
(2) Elephant grass—100lb.
(3) Guinea grass—100lb.
(4) Banana trash.
(5) Compost—amounting to approximate equivalent of 100lb.—fresh material.

Half plots 1/2lb. sulphate of ammonia after long rains.

NOTE.—This experiment is a modification of XIV based on experience. Cover crops grown *in situ* are omitted and variation in plant material is reduced by the use of clones.

Selection Garden.—This will consist of plots of trees raised from seed of the selected coffee trees.

Progeny Plot.—This will be planted with seed from one tree, the seed prior to planting in the nursery having been graded by size.

Observation Plot.—This will contain any crosses which have been effected between high yielding coffee trees.

Hybridization Work.—No further hybridization or selfing work with coffee was undertaken during the year, as the season was such that any attempt at controlling flowering was rendered impossible. The previous season's work

was successful and the seed obtained has been planted in the nursery and will probably be ready for planting in the observation plot this season.

OBSERVATIONS.

Observations on (1) the behaviour of soils from various estates where uniformity trials are being carried out, and (2) clonal material planted in those soils; the only variant is therefore the soil.

A cubic metre of soil was brought from each of eight sites, and packed layer by layer into their respective concrete tanks. The coffee, all raised vegetatively from one parent tree and chosen for equal size, was planted on the 23rd September 1935, two months after rooting.

Soil Drainage (Gallons). 1936.

Month	Estate							
	C	D	E	F	L	N	O	C.R.S.
18th to 30th April ...	49·5	26·2	45·8	33·3	34·2	32·9	29·1	40·6
May	80·4	36·2	75·6	64·0	66·3	36·3	38·6	37·1
June	33·1	18·9	16·5	17·4	17·1	8·6	10·2	3·4
July	11·4	15·3	18·8	15·3	10·3	5·3	8·7	5·5
Total ...	174·4	95·6	156·8	130·0	127·9	83·1	86·6	86·8

Mean, 117·8.

Soil Drainage (Gallons). 1937.

Month	Estate							
	C	D	E	F	L	N	O	C.R.S.
April	50·4	40·0	65·5	48·2	47·5	22·1	34·1	41·0
May	72·5	58·2	65·7	58·8	53·5	35·3	21·6	48·9
June	10·7	4·2	5·0	3·5	5·3	3·6	2·6	1·2
Total ...	133·6	102·4	136·2	110·5	106·3	61·0	58·3	91·1

Mean, 100·0.

The plant in soil from estate E flowered and set fruit in January 1937. The plants in soil from estates D and C.R.S. flowered in March 1937 but did not set fruit.

The following table gives the diameter of the various plants at 7·5cm. above soil level in 1936 and 1937.

TABLE XV.

Soil from estate	Diameter at 7·5cms above soil level	
	30/3/37	14/2/38
C	2·7 ...	3·9
D	2·9 ...	3·0
E	3·0 ...	4·1
F	2·8 ...	3·8
L	2·6 ...	3·8
N	2·6 ...	3·8
O	2·3 ...	3·9
C.R.S.	2·9 ...	4·2

The trees in soil from estate N suffered severely from the effects of leaf miner in October 1936. All the trees have set a small crop this year. There are considerable differences between the leafage of the trees in the various soils. E, D and O have the smallest amount while C.R.S. has the greatest. The leafage of E became yellow in September probably due to its having a crop.

COFFEE GROWN IN SAND CULTURE.

Eight coffee plants grown in sand culture since eight months old have been brought to the fruiting stage.

Up to the present these have received a complete nutrient solution. When the cherry is a little farther advanced the amount of nitrogen, potash or phosphate will be reduced and any characteristics noted which may be due to lack of one or other of these nutrients.

EXPERIMENTS AND DEMONSTRATIONS ON ESTATES AND NATIVE HOLDINGS.

In connection with experiments, uniformity trials and demonstrations, records were made of individual tree yields on 28 plots in the Moshi and Arusha districts during the season. Eight of these plots are in the Arusha district, which necessitated a Recorder being stationed in Arusha from June to December.

Arrangements were made for the following to be done on estates and native holdings in 1937:—

Experiments.—Five additional experiments were superimposed on blocks recorded for the previous three years. These are given below:—

(1) To study the effects of the application of various organic substances on the water-holding capacity of non-retentive soils where irrigation is necessary. (Two estates.)

(2) To study the effects on yields of single stem trees of four different types of pruning. (One estate.)

(3) To investigate the effects of various strengths of Bordeaux mixture in controlling *Hemileia vastatrix*. (One estate.)

(4) To investigate the effect of various proprietary products in the incidence of *Hemileia vastatrix*. (One estate.)

This brings the total number of experiments on estates and native holdings to nine.

Demonstrations.—The following demonstrations were arranged:—

To investigate the best type of material and methods of establishing coffee: (a) in old coffee land; and (b) between old coffee, the old coffee to be removed after one year. (Two estates.)

Uniformity Trials.—Eight additional uniformity trials were undertaken this season, five on estates and three on native holdings. One of these latter uniformity trials is of particular interest since the coffee in the plot is raised from seed of trees which have been recorded for a period of four years. The yields of the parent trees are given below:—

Tree No.	Cherry in kilogrammes				Average
	1934	1935	1936	1937	
H 52	13·98	1·54	6·35	14·72	9·15
53	10·59	0·74	4·78	6·90	5·75
54	8·97	1·56	7·52	4·12	5·54
55	11·41	3·19	6·08	3·75	6·11

The four trees have given an average equivalent to 1·1 kilogrammes of parchment coffee per tree over a period of four years. The progeny of these trees are now four and half years old and their records for one year (1937) show that the average yield per tree is 4·2kgs cherry which is equivalent to 0·7kg. parchment coffee.

In the case of experiments on estates and native holdings observations have been made on the effect of treatments on the vegetative characters of the coffee in the various plots.

Individual Tree Selections.—Notes have been made at various times during the season on the coffee trees included in the list of selections. These notes concern vigour, incidence of Hemileia, leafage and flowering prospects. The total number of selections is 138. Seed has been obtained from these trees.

Projected Experiments for 1938.—The following experiments are to be laid down:—

(1) To find out the effects of composts of different strengths on the yield of *C. arabica* on a volcanic ash and their effect on soil texture. (One estate.)
(2) Trials of seedling progeny from selected trees. (Eleven estates.)
(3) To investigate the effect on yield of allowing single stem coffee to attain a greater height (5ft 6in.). This is being done in an area where trees are kept low (4ft 6in.).

Demonstrations.—As a result of the general indications obtained from experiments on the value of farmyard manure and sulphate of ammonia on the yield of coffee, two large-scale demonstrations have been arranged in the Moshi district and five in the Arusha district. This demonstration will consist of the following treatments:—

(1) Control. (No treatment.)
(2) Sulphate of ammonia (1lb. per tree).
(3) Pen manure (70lb. per tree).
(4) Sulphate of ammonia ($\frac{1}{2}$lb. per tree) together with pen manure 35lb. per tree).

ADVISORY AND LIASON WORK.

Forty-one visits to estates in the Moshi and Arusha districts were made during the period October to December 1937 and much useful information obtained. In all cases the experimental work being done on estates and at the station was brought to the notice of the planter and the need for higher standards of husbandry emphasized.

A consideration of the weather conditions prevailing during the season and their effect on the coffee generally is of interest. This is particularly so if a comparison is drawn between the conditions prevailing this season and those of other seasons in the light of their effect on coffee.

Usually the period of October-December is the important time to see coffee in the Moshi district, the problems, induced and inherent, being then most marked. This is attributed to the strain imposed on the tree by the ripening of the crop. During this season, however, peculiar weather conditions have prevailed and, under these conditions, dieback and leaf fall have been far less obvious despite reasonably good crops in many places.

October, November and up to mid-December of 1936 were hot and dry and a good deal of flower bud appeared. Rain fell in practically all districts at the end of December causing one large flowering. In 1937 January, February

and March were hot and dry. Abnormally heavy rains fell in April and May; June, July and the begining of August were cold and cloudy with the average amount of rain. During the latter part of August and the whole of September hot sunny weather prevailed and then in October and November, light but effective rains fell.

The effect of such a season on coffee was to delay picking by about six weeks on the lower estates. As a result of the warmer dry weather in August and September together with light showers of October, the coffee in the middle and upper belts ripened at an unprecedented rate, and picking was completed earlier than usual.

The absence of any dieback was a noteworthy feature although in August it was generally expected that, as a result of ripening being extended over a long period, dieback would be severe in the middle and upper belts towards the end of the crop.

During the season 1929-30 rain fell each month from September to June and the rains of March, April and May were very heavy. No further effective rains fell until December. In July and August 1930 the coffee showed signs of yellowing and a considerable amount of dieback occurred. The extent of the dieback and exhaustion is reflected in the crop for the following season.

The season 1932-33 differs again from either the season 1936-37 or 1929-30. The conditions and their effects were described in 1933 as follows:—

> "The blossom showers of December 1932 were late but were sufficient to bring out a good flowering, during January, February and March effective rains fell, these months are normally dry.
>
> During April, May and June heavy rains are usually experienced and generally speaking in what is considered a normal year the rains of these months are excessive, a condition approaching waterlogging occurs with consequent deleterious effect on the tree, particularly if a heavy crop is being borne. Yellowing and dieback being the symptoms. During the year under review the rains of April, May and June were extraordinarily light compared with the average year and although on the lower slopes the rainfall was insufficient, on some of the higher estates the rainfall might be considered to have been nearer the ideal than is the case in the average or normal year; as a consequence the yellowing so prevalent during the very wet season of 1929-30 did not occur and there has been very little dieback.
>
> The result of the comparative failure of the April to June rains and the subsequent hot weather was that the crop ripened up much earlier than is usually the case. The rains of January and February caused an increase over the normal in the amount of vegetative growth and the failure of the April rains caused the cessation of that growth some two months prior to the normal time and the consequent earlier maturing of that vegetative growth, this is instanced by the fact that spike was obvious in many areas as early as August."

Experiments indicate that in seasons of heavy rainfall the application of quickly available nitrogen after the cessation of the rains has beneficial effects on the coffee both vegetatively and in yield. In addition it has been shown that the nitrogen status of the soil is low during periods of heavy rain, the nitrate being leached through the soil beyond root range. In drier periods the nitrate content of the top foot of soil increases considerably and with light rains the nitrates are washed down but remain within root range.

From the above observations on the effect on coffee of the varied distribution and intensities of rainfall in particular seasons and the combined knowledge of the nitrogen status of the soil under different conditions of rainfall, and of the indications obtained from the application of nitrogen, is the problem as it appears, namely, that the availability of nitrate to the coffee plant is the important factor in affecting the incidence of yellowing, dieback and the rate of ripening.

In June and July 1937 there was some cherry fall, the cherries becoming black around the base of the peduncle and dropping to the ground. A similar condition occurred on the higher estates in 1930. This condition is not considered to be due to a fungus but it is suggested that it is physiological, probably connected with faulty nutrition.

Spraying against *Hemileia vastatrix* was general, the abnormal rains of October and November 1937, in addition to causing a flush of new leaf, also creating conditions entirely suitable for the increase of the incidence of Hemileia, so much so that in many areas a very high percentage of leaves showed infection by December. In these circumstances the pre-monsoon spraying will give protection to but a few leaves, and it may be necessary to spray again subsequent to the rains of April-May 1938.

Leaf miner has been serious this season, in fact, the leaf fall resulting from attack by this pest has assumed more serious proportions than loss of leaf from Hemileia infection. Nicotine sulphate is used to deal with the pest and in almost all cases it is incorporated with Bordeaux mixture applied in January and February. In many instances it has been ineffective, due no doubt to the fact that the pest was not in a vulnerable stage when the nicotine sulphate was applied. One planter effectively controls the incidence of leaf miner by spraying with nicotine sulphate when the pest is in the pupal stage on the underside of the leaf.

Antestia lineaticollis has caused a good deal of damage. There was a high incidence in June-July and weather conditions at that period did not allow of effective spraying with Sodium arsenite bait. Several planters intend using pyrethrum as a post-monsoon spray against this pest. On many estates damage, thought to be due to Antestia, resulted in a darkening of the silverskin. This may have been due to Antestia damage in ripe beans.

The rains of October-November although entirely beneficial from the point of view of ripening the crop caused trouble with the flowering for next season's crop. The dry period of August-September caused a certain degree of maturation of the young wood accompanied by the appearance of flower bud in October and November: this flower bud opened and set with the November rains. With these rains much young shoot growth appeared and older growth, not sufficiently mature to flower, continued growth and flowered to a small extent only and then over a long period, in effect a series of small flowerings over a period of six weeks. Where intermittent flowering occurred (i.e. everywhere with the exception of estates and holdings which had no crop in 1937), much trouble was experienced with Capsid damage to the young flower buds and in one or two cases damage to the extent of twenty-five per cent to thirty per cent of the unopened flower buds was observed in mid-December.

Owing to unfavourable weather conditions some flower bud did not mature as a result of being scorched by the hot sun of December and January. It is of interest to note that the lower Usa and Nduruma estates in the Arusha district

had favourable conditions for early ripening during 1937 and that these estates had a satisfactory flowering with the October and November rains, i.e. the wood had matured and formed sufficient spike in time for the October and November rains to open it.

A peculiar condition has occurred in the Ngare Olmotonyi area, where in October there was a very good spike but instead of opening and setting it fell off. No damage was observed in the spike. This fall of unopened flower bud may be correlated with a heavy leaf fall occurring earlier in the year. It should be noted that in these areas although very little crop, if any, was borne in the 1937 season, dieback was observed, even on trees in heavy spike.

The standard and type of pruning of single stemmed coffee shows considerable improvement but still there is a tendency to allow the tree to reach its final height too quickly: where this latter system prevails the lower primaries are quickly lost. Some planters are converting small areas of coffee to the multiple stem system for trial purposes. In the zone where stem borer is serious the change over is viewed with apprehension.

Additional interest has been shown by planters in anti-erosion measures, but it is still difficult to get work done.

The coffee crop from the plantations in the Moshi district for the season was approximately 1,400 tons clean coffee, which means an average yield of approximately 3½cwt. per acre. There are many estates which over areas of one hundred acres or more have yielded an average of 8cwt. per acre for three years or more.

If the fullest benefit is to be derived by the industry from the results obtained at this station during the next three to four years it is essential that the general standard of agriculture be raised. Soil conditions must be improved by the general accepted agricultural methods, namely, addition of humus (by farmyard manure or compost and mulching) and anti-erosion measures undertaken. This applies even where the coffee is in reasonable condition.

There are considerable areas of coffee which are not economic and even with high prices it would be a waste of labour to cultivate them. Portions of these areas should be uprooted and the land given every attention for two to three years and prepared for planting good material and the remainder utilized for the provision of mulch or green material for compost.

Lyamungu,
March 1938.

F. R. Sanders
Agricultural Officer

Section VI.

Report of the Chemist.

1. *Soil Survey.*—(a) The investigation of the nutrient status and physical constants of the soils on which uniformity trials and field experiments have been laid down, has been continued. Analytical data of a further six profiles are tabulated below:—

BRIEF FIELD NOTES.

Kibosho.—Altitude 4,000 feet. Rainfall 60 inches. Kilimanjaro lava soil. A deep chocolate-red friable clay loam. Large boulders are found in the subsoil.

Kikafu.—Altitude 3,900 feet. Rainfall 40 inches. Kilimanjaro lava soil. Red chocolate friable loam overlying a red clay loam.

Machame.—Altitude 4,500 feet. Rainfall 60 inches. Kilimanjaro lava soil. Friable, dark chocolate clay loam of great depth.

Machame.—Altitude 4,500 feet. Rainfall 60 inches. Kilimanjaro lava soil. Very soft and friable chocolate sandy loam overlying a more compact loamy clay at a depth of three feet. The deeper horizons are nut-like in structure with a concretionary horizon below six feet.

Machame.—Altitude 4,500 feet. Rainfall 60 inches. Kilimanjaro lava soil. Friable, dark chocolate brown clay loam of great depth.

Mbosi.—Altitude 4,600 feet. Rainfall 46 inches. Derived from gneiss with dolerite. Light brown fairly friable loam overlying a bright red clay of considerable depth.

(b) *Extended Survey.*—The examination of samples representative of the soils in the Oldeani area has been completed. In texture these soils are very deep, freely drained clay loams, black at the higher altitudes and red on the lower slopes.

Chemically all are very rich in mineral nutrients and approximately neutral in reaction. The humus content is high at the higher altitudes (on the "Black Soils"), the organic carbon content being six to eight per cent. The "red soils" of the plains on the other hand only contain about two per cent of organic carbon.

Soil improvement, after the prevention of erosion, should be directed towards increasing the humus content of the red soils: their low humus content combined with poor rainfall suggest that a low level of nitrogen nutrition and moisture supply are limiting soil factors in plant growth. The red soils should also respond to heavy vegetable mulching.

ANALYSIS OF FINE EARTH

	Reaction		% C	% N	C/N	Exch. Bases m.g.e. %		P_2O_5 r.a. ppm.	Air Dry H_2O %	Sticky Point H_2O %	Sand %	Index of Texture
	pH. Water	KCl				Total	K_2O					
KIBOSHO.												
Comp. ...	5·8	4·9	4·03	·371	10·8	18·3	1·91	420	10·0	—	—	—
1	5·8	4·9	3·66	—	—	17·1	2·28	320	10·0	45·5	17·5	42·5
2	6·2	5·2	2·20	—	—	16·3	2·15	190	10·0	45·5	17·0	42·5
3	6·6	5·7	1·22	—	—	15·9	2·70	140	10·5	48·0	15·0	45·5
4	6·7	5·8	·93	—	—	14·7	2·74	88	11·5	48·0	14·5	45·5
5	6·9	5·8	—	—	—	13·4	2·06	100	13·5	48·0	11·5	46·0
6	6·9	5·7	—	—	—	9·4	1·66	72	11·0	51·0	13·0	49·0
7	6·1	5·2	—	—	—	9·4	1·38	90	13·0	52·5	12·5	50·5
8	5·7	4·7	—	—	—	9·4	1·01	100	13·0	53·0	13·5	51·0
KIKAFU.												
Comp. ...	6·8	5·8	3·24	·214	15·1	22·0	2·10	370	6·0	43·0	—	—
1	6·4	5·7	2·89	—	—	21·2	1·97	320	5·5	43·0	9·5	41·5
2	6·6	5·8	2·67	—	—	21·6	1·83	570	6·0	42·0	9·5	40·5
3	6·6	5·6	1·50	—	—	12·7	·99	190	5·5	41·5	9·0	40·0
4	6·5	5·6	1·11	—	—	9·8	·74	172	5·0	42·0	9·0	40·5
5	6·6	5·7	—	—	—	8·5	·50	96	5·0	42·5	8·0	41·0
6	6·5	5·7	—	—	—	6·4	·23	100	5·0	43·5	8·0	42·0
7	6·9	5·9	—	—	—	6·4	·18	50	5·0	44·5	7·5	43·5
8	6·7	5·9	—	—	—	5·1	·33	30	4·5	43·5	7·5	42·5
MACHAME.												
Comp. ...	6·1	5·0	3·69	·391	9·4	14·3	1·93	312	13·0	47·0	—	—
1	6·1	4·9	3·45	—	—	14·3	1·87	312	14·0	48·0	11·0	46·0
2	6·1	4·8	2·78	—	—	12·6	1·96	291	11·5	49·0	10·5	47·5
3	6·4	5·0	2·35	—	—	13·6	·57	210	12·5	46·5	12·0	44·5
4	6·4	5·1	1·90	—	—	12·6	·54	90	12·0	45·5	12·0	43·5
5	6·4	5·1	—	—	—	12·0	·42	90	13·5	45·0	11·5	43·0
6	6·5	5·1	—	—	—	12·0	·38	48	14·0	48·0	11·0	46·0
7	6·4	5·2	—	—	—	10·0	·39	—	14·5	49·5	10·0	48·0
8	6·3	5·2	—	—	—	9·5	·42	60	16·5	53·0	10·0	51·5

ANALYSIS OF FINE EARTH—(*contd*).

MACHAME.

	Reaction		% C	% N	C/N	Exch. Bases m.g.e. %		P_2O_5 r.a. ppm.	Air Dry H_2O %	Sticky Point H_2O %	Sand %	Index of Texture
	pH. Water	KCl				Total	K_2O					
Comp. ...	6·6	5·4	3·40	·348	9·7	23·6	3·00	758	13·0	44·0	—	—
1	6·6	5·6	2·90	—	—	25·3	3·06	780	12·0	46·5	18·0	43·5
2	6·7	5·6	2·40	—	—	24·8	2·95	695	12·0	46·5	17·5	43·5
3	6·9	5·7	2·08	—	—	21·9	3·73	446	13·0	47·0	15·5	44·5
4	6·7	5·7	1·65	—	—	17·4	3·98	170	14·5	49·0	10·0	47·5
5	6·6	5·7	—	—	—	—	—	111	16·0	49·5	8·5	48·0
6	6·6	5·5	—	—	—	11·6	4·35	62	16·0	50·5	9·5	49·0
7	6·2	5·2	—	—	—	—	·77	—	15·0	49·0	11·0	47·0
8	6·2	5·3	—	—	—	9·5	·52	76	15·5	46·0	12·5	44·0

MACHAME.

Comp. ...	6·5	5·7	3·96	·362	10·9	21·5	2·12	—	13·0	47·5	—	—
1	6·1	5·2	3·16	—	—	20·9	2·18	657	10·5	46·5	11·5	44·5
2	6·3	5·6	2·93	—	—	20·9	1·89	863	10·0	47·5	11·0	45·5
3	6·6	5·4	2·28	—	—	—	—	676	11·0	47·5	10·0	46·0
4	6·6	5·5	1·62	—	—	12·6	1·51	756	11·5	47·0	9·0	45·5
5	6·0	5·1	—	—	—	—	—	568	12·0	48·0	8·0	47·0
6	6·0	4·8	—	—	—	10·8	1·03	179	15·0	51·5	8·0	50·0
7	6·0	5·0	—	—	—	—	—	—	14·5	52·0	7·0	51·0
8	6·2	5·0	—	—	—	9·9	1·06	80	13·0	53·0	6·5	52·0

MBOSI.

ANALYSIS OF FINE EARTH—(*contd*).

	Reaction		% C	% N	C/N	Exch. Bases m.g.e. %		P_2O_5 r.a. ppm.	Air Dry H_2O %	Sticky Point H_2O %	Sand %	Index of Texture
	pH. Water	KCl				Total	K_2O					
Comp. ...	5·8	4·7	2·43	·146	16·6	7·6	1·11	26	5·5	32·0	—	—
0–6″ ...	5·1	4·3	1·96	—	—	3·9	·77	20	4·5	32·5	30.0	27·5
6–12″ ...	5·2	4·3	1·71	—	—	4·8	·71	12	5·5	32·5	31.5	27·5
1–2′ ...	5·2	4·6	0·58	—	—	4·6	1·17	12	7·5	41·5	20.0	38·0
2–3′ ...	5·5	4·7	0·30	—	—	5·0	1·53	4	8·5	42·0	26.5	37·5
3–4′ ...	5·5	4·8	—	—	—	4·6	·92	6	5·0	38·0	29.0	32·0
4–5′ ...	5·7	5·0	—	—	—	4·8	·77	8	5·5	38·5	26.5	34·0
5–6′ ...	5·7	5·1	—	—	—	3·9	·71	16	4·5	38·5	25.5	34·0

NOTES

Soil reaction ... ... = Is measured in pH units both in water and in normal KCl solution.
C% ... ... = Percentage organic carbon. For conversion to organic matter, multiply by 1·724.
N ... ... = Total nitrogen.
Exch. Bases ... ... = Exchangeable bases, measured in milligramme equivalents per 100 grammes of soil (m.g.e.%).
P_2O_5 r.a. ... ... = Readily available P_2O_5, viz., that soluble in N/500 sulphuric acid, buffered to pH 3·0.
ppm. ... ... = Parts per million.
Air Dry H_2O ... ... = Moisture driven off when the air-dried soil is heated at 100–105 C.
Sticky Point H_2O ... ... = Moisture content of soil when kneaded to the maximum degree of stickiness expressed on oven-dry weight.
Index of Texture ... ... = Is measured by subtracting from sticky point moisture the amount of moisture supposed to be held by the sand fraction.
Comp. ... ... = Composite sample of top soil.
Nos. 1 to 8 ... ... = Represent depths of soil in the profile: 0–6in., 6in.–12in., 12in.–18in., 18in.–24in., 24in.–36in., 36in.–48in., 48in.–60in., 60in.–72in., respectively, unless otherwise stated.

Studies in Nitrification and the effect of Vegetable Mulches.

Periodical observations have been continued on the production of nitrate as described in the annual report of 1936. It was particularly desirable to obtain information as to the nitrate status of the soil in the months following the long rainy season, namely, from June to December.

As in the 1936 rainy season, the nitrate content of the top soil was soon reduced to a low level, owing to the leaching action of continued heavy rain. Examination of leachings from different soils, placed in metre cube tubs, were made throughout this period: the amount of nitrate leached beyond a depth of one metre varied between 23 and 60 pounds of nitrogen per acre in ten weeks.

The replenishment of nitrate in the months succeeding the long rains was slow. (*Note.*—Almost all plants respond to applications of nitrogenous fertilizers at this time of the year). The accompanying diagram* depicts graphically the effect of two kinds of vegetable mulch on the nitrification process. The mulches used were: (a) guinea grass containing 1·7 per cent nitrogen and a C:N ratio of 27:1 and (b) dry banana leaf containing 1·2 per cent nitrogen and a C:N ratio of 40:1.

Attention is called to the following main points:—

(1) The plots treated with banana trash in 1936 produced more nitrate in June 1937 (before renovation of the mulch) than those of other treatments: an important point in view of the generally low nitrate content at this time of year.

(2) The nitrate status is considerably higher under the banana mulch throughout the dry weather: during a period of occasional rains which were not heavy enough to cause leaching but sufficiently so to penetrate 12 to 18 inches.

(3) After moderate rains which transport nitrate from the surface into the immediate subsoil and root zone the resumption of nitrification in the surface soil is more pronounced under banana leaf mulch.

This is well illustrated by conditions tabulated below:—

Nitrate Nitrogen in Parts per Million of Soil.

Treatment	A 4/8/37	B 6/8/37	C 27/8/37
Banana leaf mulch ...	37·0	18·0	37·0
Grass mulch	23·5	14·0	18·0
Bare soil	18·0	12·5	21·0

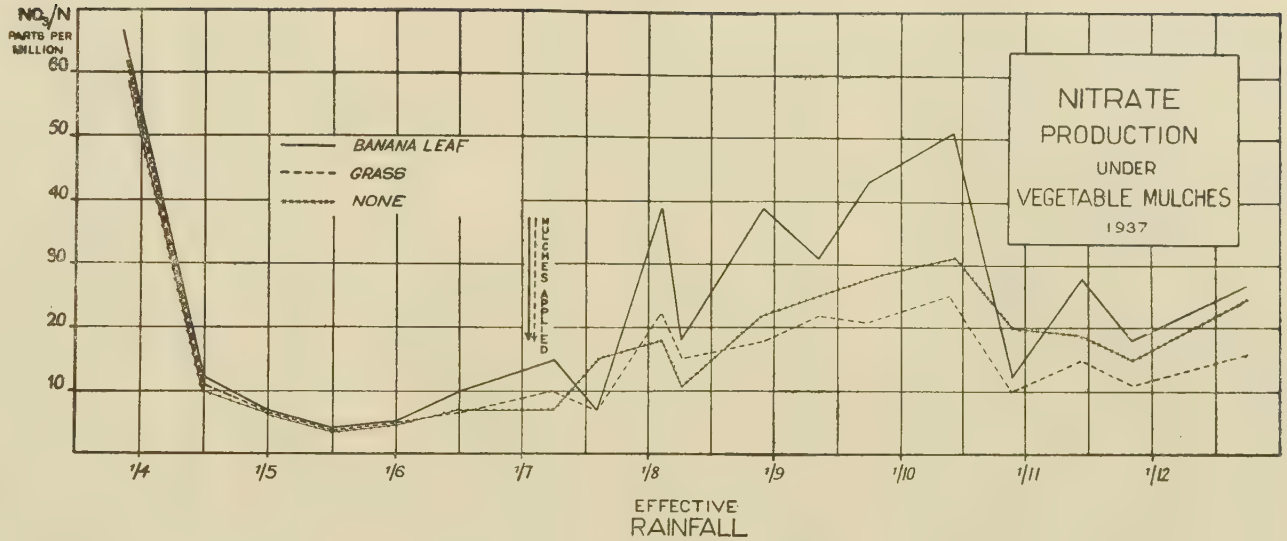
The fall in nitrate content from A to B is a result of 33mm. of rainfall. C represents conditions three weeks later, after a period of warm weather with occasional light showers.

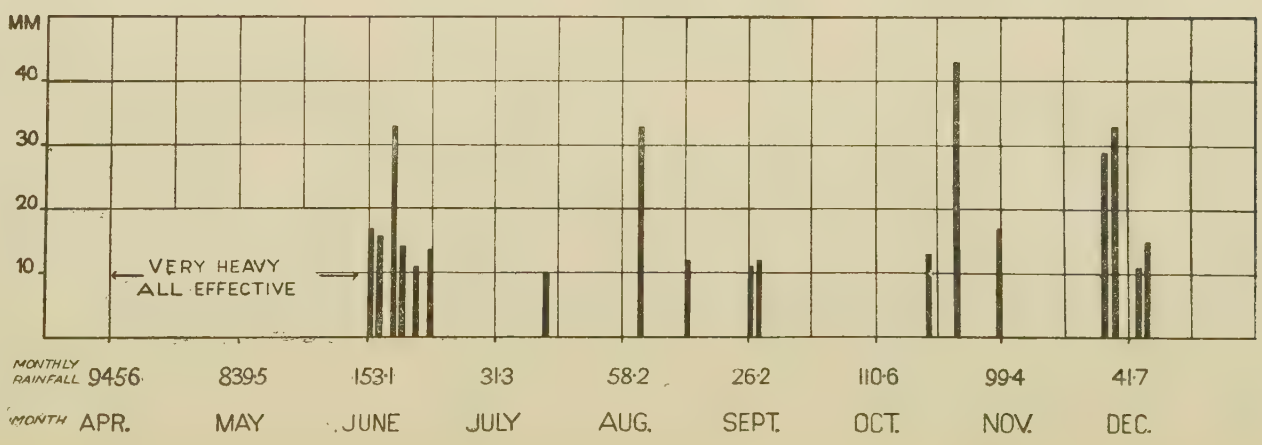
(4) The grass mulch depresses nitrate production throughout the period under review.

This difference in behaviour between the two types of mulch is due to the fact that the grass breaks down too easily: presumably it contains sufficient nitrogen to start microbiological decomposition but insufficient to do so thoroughly without robbing the soil, to some extent, of nitrate. Banana trash, on the other hand with a higher C:N ratio markedly resists decomposition and acts more as an effective soil cover, conserving soil moisture and maintaining more even temperatures.

*See Graph IV.

Graph IV


NO3/N
PARTS PER MILLION
60
50
40
30
20
10
BANANA LEAF
GRASS
NONE
MULCHES APPLIED
NITRATE PRODUCTION UNDER VEGETABLE MULCHES 1937
1/4
1/5
1/6
1/7
1/8
1/9
1/10
1/11
1/12


EFFECTIVE RAINFALL
MM
40
30
20
10
VERY HEAVY ALL EFFECTIVE
MONTHLY RAINFALL 94·56 839·5 153·1 31·3 58·2 26·2 110·6 99·4 41·7
MONTH APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

FIELD PROBLEMS.

(a) *Ngare Olmotonyi Area.*—The possibility that recent crop failure and abnormal leaf fall may be attributed to a mineral deficiency is under investigation. Periodical samplings of coffee leaves are being made for analysis.

(b) *Sanya Area.*—An unusual form of chlorosis and dieback is under investigation.

(c) *Mbosi.*—Soil samples have been taken from coffee estates which had been sampled four years previously in order to see whether any appreciable change in humus content had occurred during this period.

In most cases no fall in humus content is evident: it appears that the annual loss is made good by weed growth and remedial measures taken to maintain humus content. In general, however, the humus content in this area is still low.

(d) *Irrigation Studies.*—At Ngare Nairobi, soil moisture determinations were made to find out the distribution of soil moisture after irrigation of a dry soil.

This area is well suited for such a purpose in that here the soil and subsoil dry out to a point considerably below the field moisture capacity and approaching the wilting point. Further the clay fraction which forms 60 per cent of the soil mass more resembles a "fat" clay than is the case on other parts of Kilimanjaro—the SiO_2/Al_2O_3 ratio being 2·3—and moisture movements might be expected to be sluggish.

It was found that water applied to this dry soil reaches equilibrium fairly rapidly at a moisture content corresponding approximately to the moisture equivalent.

MISCELLANEOUS.

(a) A method of rapidly determining specific gravity of coffee beans was devised for investigating a possible correlation between density of bean with liquoring quality.

(b) Samples of nicotine, compost and guano have been analysed for planters and departmental officers.

Lyamungu,
March 1938.

H. B. Stent
Chemist

Section VII.

Report on Plant Pathology.

From the 7th March until the 12th December I was absent from the Territory on vacation leave. During that period routine work and observations on experiments were carried out by the Entomologist until his departure on leave on the 24th August; and several problems were dealt with at Amani by favour of the Plant Pathologist.

There were published during the year: "A Revised List of Plant Diseases in Tanganyika Territory" (already mentioned in the 1936 report), and an article entitled "Notes on the Susceptibility of Indigenous Trees to Armillaria," in the *East African Agricultural Journal*, Vol. III, No. 1, July 1937. Reprints are available from the laboratory.

HEMILEIA.

Experiments.—A native block of Arabica coffee which had been recorded for crop for the three years 1934 to 1936, was used for an experiment designed to compare a proprietary soluble copper hydroxide fungicide with Bordeaux mixtures of 1·0 and 0·5 per cent. Spraying was carried out on the 15th February, each treatment comprising five plots each of twenty trees. Control plots were untreated. When examined in August there was little difference between the two Bordeaux treatments, but both were better than the copper hydroxide treatment, and all were better than the controls. This experiment will be repeated in 1938 and observations will be made of the effect on cropping as well as of the disease itself. In 1937 there was an insignificant amount of crop.

On 15th-16th March, after my departure on leave, a recorded block of coffee became available for a spraying experiment. This was started by the Agricultural Officer. Treatments were three strengths of Bordeaux, full, three-quarters and half strength, with untreated controls. Each treatment was carried out on four plots each of twenty trees. This experiment is also being continued.

General.—Hemileia disease in the Southern Highlands province continues to spread; control by spraying is being undertaken. The disease was first observed near Tukuyu in November 1936. By April 1937, it had spread to another large plantation, and in June to local native holdings. In May it was seen on a plantation at Mbosi. While the source of the disease cannot be discovered, there is little doubt that the increase of coffee planting in recent years has extended the receptive area on which spores, probably carried in by winds from the endemic regions outside the province, could alight. Extension of planting has also increased the range of atmospheric condition under which coffee is now growing, and this may have provided conditions under which introduced spores could become established.

Among the routine queries on coffee diseases in correspondence, there are none requiring comment here. Damping-off of cuttings and seedlings in frames and boxes, associated with a species of Rhizoctonia, was referred to in the previous report. The application of Cheshunt Compound has the disadvantage of rendering the rooting media too wet, but by other measures, chiefly preventive, the disease has been kept within reasonable bounds. The parasite is not invariably associated with deaths in the young plants, but with improvement of conditions the great majority are preserved. When the young plants are transferred from the frames to the field no further trouble arises.

Gypsum was applied both in the field and in the greenhouse to soil on which an unusual form of yellowing of coffee and Canadian Wonder beans occurred and which was referred to in the previous report. No benefit resulted after the application of gypsum to coffee trees and beans even at the rates of three and six tons per acre for a few trees.

Lyamungu,
March 1938.

Geo. B. Wallace
Plant Pathologist

Section VIII.

Entomologist's Report.

From the beginning of the year until the 24th August I was on duty at the station, when I went on home leave.

The main problem attacked during the year was that of coffee leaf-miner. Two species are involved, *Leucoptera coffeella*, Guér., and *Leucoptera daricella*, Meyr.

Ritchie (Report Dept. Agric. 1934) stated:

> "Heretofore *L. coffeella*, Guér. has been looked upon as the prevalent leaf-miner. Examination shows that *L. daricella*, Meyr. amounted in plantations subject to a miner wave in 1934 to 87·5 per cent of the *Leucoptera* population and in less affected plantations to 62 per cent."

During the present year it was found that whilst severe infestations under shade consisted almost exclusively of *L. daricella*, Meyr., severe infestations in unshaded coffee occasionally consisted almost entirely of *L. coffeella*, Guér. Thus the severe incidence of leaf-miner in this area, as compared with other coffee growing areas in East Africa, is not entirely accounted for by the presence of *L. daricella*, Meyr., and both species therefore require study.

A study of the moths and parasites was commenced by regular collections from two different areas. A number of new species are recorded, identified by the Imperial Institute of Entomology as follows: (Braconidae) Genus (Nov. ?) near *Hormius*; (Encyrtidae) *Ageniaspis* sp. ?; *Achrysocharis* sp., *Syntomosphyrum* sp.; (Mymaridae), *Polynema* sp.; (Scelionidae) *Telenomus* sp. These, with Dr Ferriere's list (*Bull. Ent. Res.* Vol. 27, Pt. 3, p. 477) make a total of 22 parasites and hyperparasites of the two species of *Leucoptera*. Of the new species, the first and second are important. The relations of these insects, and their relative abundance during the year, are being worked out. Some work on insecticides to control leaf-miner has been carried out, but as yet no recommendations can be made.

Thrips.

Early in November of the previous year, from a study of the temperatures recorded on the station, it was possible to forecast that a Thrips outbreak was probable during the early months of 1938. This forecast proved to be correct both for the Kilimanjaro area and Arusha; the year was described as the worst for Thrips for several years. The forecast made for 1938 was that little damage need be anticipated from Thrips.

During the outbreak Thrips was successfully bred in the laboratory by means of a high temperature chamber, and this stock was kept going for a considerable time, but died out later in the year. Further studies on the climatic requirements of Thrips are projected. The fundamental control of Thrips is shade, and the avoidance of windbreaks. Where the use of shade is impracticable, early forecasts of Thrips outbreaks to enable adequate measures to be taken are of value. Some tests of insecticides against Thrips were carried out, which suggest that Derrisol, one part in 500 parts of either water or Bordeaux mixture is very useful, and considerably cheaper than nicotine sulphate.

Counts of Thrips in the field during the latter part of the outbreak were carried out, and found to be closely correlated with the maximum day temperature, with a lag of ten days before the temperature took effect on the number of Thrips.

ANTESTIA.

Very little Antestia was present during the early part of the year, and experiments projected had to be abandoned for lack of suitable infestations.

OTHER INSECTS.

Two species of *Stephanoderes* were discovered in *Mbuni* coffee, but neither proved to be the serious pest of coffee *Stephanoderes hampei*, Ferr. They are identified as *S. uniseriatus*, Egg. and *S. lineatus*, Egg. Neither appears to be a harmful species.

Some damage was apparent to coffee flower buds in the Kilimanjaro area from Capsid, probably *Lygus coffeae*, China. A note on the subject was prepared for the *Monthly Notes* of the station.

Experimental baitings with maize flour and Paris Green (1 : 50) against *Dasus* (*Gonocephalum*) *simplex* F., Dusty Ground Beetle, gave kills of 90·9 to 98·5 per cent. The opportunity to study the incidence of this beetle under different methods of ground treatment in Experiment XIV was taken, the noteworthy observation being the almost complete absence of this beetle under banana mulch. Experimental work in the laboratory showed that this beetle is unable to damage a sound coffee seedling, but is able to enlarge injuries caused either mechanically or by cutworm until these may become fatal.

Lyamungu,
March 1938.

F. B. Notley
Entomologist

STATEMENT OF EXPENDITURE FOR THE PERIOD OF THE 1ST JANUARY TO THE 31ST DECEMBER 1937

Colonial Development Fund—V. Coffee Research Station

I.—PERSONAL EMOLUMENTS

	Provision Shs	Expenditure Shs Cts
1. Chief Scientific Officer		22,814 46
2. Chemist		13,949 98
3. Agricultural Assistant		6,722 90
4. European Clerk		2,006 00
5. Asiatic Clerk		3,071 24
6. (a) Laboratory Assistant	63,440 ...	1,450 00
(b) African Assistants		900 00
7. (a) Mechanic		1,979 91
(b) African Assistants		215 00
8. African Overseer		290 00
9. Messengers		220 30
	63,440	53,619 79
Transferred to Item 11	4,432	
	59,008	

II.—OTHER CHARGES

10. Incidental Expenses:		
(a) Stationery	840 ...	638 73
(b) Contingencies		197 30
	840 ...	836 03
11. Farm Operations and Experimental Work:		
(a) Labour		10,999 95
(b) Recorders		6,359 08
(c) Field Experiments off Station ...		795 47
(d) Upkeep and Maintenance of Motor Vehicles	21,440	1,843 90
(e) Maintenance of Power, Gas and Water Plants		1,971 59
(f) Books and Periodicals		1,058 58
(g) Laboratory Equipment and Materials		2,546 75
	21,440 ...	25,575 32
Transferred from Personal Emoluments ...	4,432	
	*25,872	

*Shs 5,720-met from Head V, Agriculture

Appendix A—Capital Expenditure—II. Coffee Research Station,
Capital Expenditure 1937 (Development)

	Provision Shs		Expenditure Shs Cts
(a) Labour	8,000	...	4,049 40
(b) Materials		...	3,907 17
	8,000	...	7,956 57

NOTE.—In addition the salaries and other charges of the Plant Pathologist, the Entomologist and the Agricultural Officer are met from departmental funds.

Appendix II

The following plant introductions were received:—

COFFEE (seed):

C. robusta selections from Uganda.
C. excelsa from Amani.
C. Dybowski ,,
C. liberica ,,
C. khasiana from India.
Chimois coffee from Mozambique.
C. liberica from North Borneo.
C. excelsa ,, ,,
C. robusta ,, ,,
C. abeokutae from Saigon.
C. excelsa ,,
C. liberica ,,
C. Arnoldiana ,,
C. arabica from Haiti.
C. arabica from Costa Rica.
C. arabica from Portuguese East Africa.
C. congensis from Belgian Congo.

COFFEE (plants):

Coffea sp. from Royal Botanic Gardens, Kew.
C. bengalensis ,, ,, ,,
C. mauritiana ,, ,, ,,
C. laurina ,, ,, ,,
C. zanquebarie ,, ,, ,,

SHADE TREES (seed):

Derris robusta from India.
Cassia capensis from Southern Rhodesia
Dalbergia sessoo ,, ,,

RUBIACIOUS PLANTS:

Ixora sp. from Royal Botanic Gardens, Kew.
Posoqueria latifolia ,, ,, ,,
Cinchona Calisaya ,, ,, ,,
Psychotria undata ,, ,, ,,
Cephaleis pedunculata ,, ,, ,,
Hymenodictylon excelsum ,, ,, ,,
Leptactina Leopoldii ,, ,, ,,
Gardenia jasminoides ,, ,, ,,
Hoffmania Gheesbreightii ,, ,, ,,
Cephaleis ipecucuanha ,, ,, ,,

C. B. GIBBINS
Agricultural Assistant